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BELL TELEPHONE QUARTERLY

JULY, 1923

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NOTES ON RECENT OCCURRENCES

American Telephone and Telegraph Company

New York

Bell System house flag as flown during the conference of Presidents
at Yama Farms

BELL TELEPHONE QUARTERLY

A MEDIUM OF SUGGESTION
AND A RECORD OF PROGRESS

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The Early Corporate Development of the Telephone

The technical growth of the telephone has been made a matter of history, but the corporate growth of the American Telephone & Telegraph Company and its predecessors is not so well known. Now that the telephone is approaching its fiftieth year and while there are people in the business who were in it from the very early days, it seems well to review the steps of its progress.

THE qualities which characterize the Bell System of the present day have all grown from right beginnings made by the small group of men who from 1875 to 1885 controlled the telephone industry and started it fairly on its way toward universal service. Bell, Sanders, Hubbard, Watson, Forbes and Vail seem, each in his own line, instinctively to have known the principles, the methods and the practice which in less than fifty years would make of the telephone a well centralized but democratic federation of companies, a sound financial institution, an efficient and progressive engineering utility, and therefore the habitual reliance of the civilized world.

While Alexander Graham Bell himself never carried the invention of the telephone beyond its elementary stage, he foresaw in very specific detail the possibilities

of universal communication to which, with the addition of the exchange and long lines systems, his invention would ultimately be developed. In an address which served as a prospectus for a group of London capitalists, dated March 25, 1878, Mr. Bell wrote (with slight omissions),—

> "It is conceivable that cables of telephone wires could be laid underground, or suspended overhead, communicating by branch wires with private dwellings, country houses, shops, manufactories, &c., &c., uniting them through the main cable with a central office where the wire could be connected as desired, establishing direct communication between any two places in the city. Such a plan as this will, I firmly believe, be the outcome of the introduction of the telephone to the public. Not only so, but I believe in the future wires will unite the head offices of the Telephone Company in different cities, and a man in one part of the country may communicate by word of mouth with another in a different place. Believing as I do that such a scheme will be the ultimate result of the telephone to the public, I will impress upon you all the advisability of keeping this end in view, that all arrangements of the telephone may be eventually realized in this grand system."

The "Bell Patent Association"

The first germ of a corporate form for the business development of the telephone was a verbal offer made by Thomas Sanders of Haverhill, Massachusetts, to Alexander Graham Bell in the fall of 1874 to supply him with money for his experimenting in return for a share in whatever patent rights might come from the work. A short time after this arrangement with Mr. Sanders, Gardiner G. Hubbard of Cambridge made Bell a similar offer. These informal offers and acceptances were later embodied in a written agreement, dated February 27, 1875.

This agreement provided that Mr. Sanders and Mr. Hubbard should each furnish one-half of the money necessary for Bell to perfect his inventions and to secure and maintain patents for them; and that the three should together own the patents. This personal association was not formal enough to have a name. To distinguish

it from other subsequent organizations it will here be called the "Bell Patent Association."

A week after this agreement of the "Bell Patent Association" was signed, on March 6, 1875, application was filed in the United States Patent Office at Washington for Patent No. 161,739, Improvement in Transmitters and Receivers for Electric Telegraphs. This patent was issued to Bell one month later, on April 6, 1875. It was the first of the tangible assets of the "Bell Patent Association." It did not, however, ever bring any financial income.

On June 2, 1875, while Bell was working with his assistant, Thomas A. Watson, to improve his multiple harmonic telegraph, he made the discovery which assured him that his theory about the electric transmission of speech was correct, and which made clear to him how to make an instrument that would produce the necessary undulatory current. Now at last he had something in the line of speech transmission that he could patent. Winning at once the approval of Mr. Hubbard and Mr. Sanders, Bell in large measure discontinued his work on the multiple telegraph and devoted his energies to developing the invention of the telephone.

The Four Fundamental Patents

In September, 1875, at his father's home near Brantford, Ontario, he began writing the specifications for the first telephone patent. In order to avoid conflict between American and British patent rights, he wished to delay the filing of the application at the United States Patent Office at Washington. So it was not filed until February 14, 1876. Credit is due to Mr. Hubbard that the application was not delayed even longer. The patent was allowed on March 3, 1876, Bell's birthday, and was issued to him on March 7, 1876, as Patent No. 174,465, Improvement in Telegraphy. It was the corner-stone of the Bell System of intercommunication.

The written agreement of the "Bell Patent Associa-

tion" did not speak of the telephone nor refer to it in a distinctive way. It stated the basis of the agreement to be that "the said Bell has invented certain new and useful methods and apparatus for telegraphing." Nor was this an instance of the interchangeable use of the two words, telegraph and telephone, common at the time, such as that in the title of the first telephone patent itself. It was either an inadvertent or a deliberate discrimination in favor of the telegraph. Mr. Sanders and Mr. Hubbard had both formerly believed that the multiple telegraph was the invention that would prove to be the profitable one, and at one time Mr. Hubbard had told Bell that their financial support was conditioned on his devoting his attention to that line of experiment.

This preference for the telegraphic inventions before long brought up a practical question of real importance, even affecting the ownership of the telephone. Dr. Bell has told about it.

> "My understanding always was that the speaking telephone was included in the inventions that belonged to the Messrs. Hubbard and Sanders from the autumn of 1874, but I found at a later period that they had not had this idea, which might account for the little encouragement I received to spend time on experiments relating to it. Even as late as 1876, when the telephone was an assured success, Mr. Hubbard generously offered to relinquish to me all right and title to that invention, as he was inclined to think it was outside our original understanding."

It was not, however, outside of Bell's original intention, and after consulting with Anthony Pollock, their attorney, Bell took the position that the telephone was to be considered as included in the agreement. So this agreement of the "Bell Patent Association" by Bell's interpretation of it became the first legal instrument of corporate telephone ownership and organization.

The experimenting of the winter of 1875-1876 culminated in another patent, No. 178,399, Telephonic Telegraph Receivers. Application was filed for this patent on April 8, 1876, and it was issued to Bell on June 6, 1876. There were now three patents to the credit of Bell and of

the support he had received from Sanders and Hubbard. Of the first of these there could be no question of its being included in the agreement of the "Bell Patent Association." Of the other two there might be reasonable question. Therefore on September 15, 1876, Bell made an assignment of these two telephone patents to the three individuals who constituted the "Bell Patent Association,"—himself, Sanders and Hubbard. This settled for all time any possible question as to whether the telephone patents were or were not covered by the agreement of February 27, 1875. Incontrovertibly this assignment constituted the three men the first telephone organization.

To the three patents within a few months was added a fourth. On January 15, 1877, application was filed, and on January 30, 1877, letters patent were issued to Bell for Patent No. 186,787, Improvement in Electric Telegraphy. These four patents were the foundation of all the early telephone organizations of the Bell System.

The Trusteeship of Gardiner G. Hubbard

The agreement of the "Bell Patent Association" had also specifically provided that if the expected inventions proved to be of value, a company should be organized to manage and control the patents; and that each of the three should own one-third of the stock of that company. By the summer of 1877 it was recognized that the condition provided for in the agreement had developed. Moreover, Mr. Bell was soon to marry Mr. Hubbard's daughter, and they were going to Europe for their wedding trip, to be gone for an extended period. Mr. Bell was to see what he could do to introduce the telephone into England. So it was advisable that the business affairs of the telephone should be put on a more definite and formal basis. Accordingly, steps were taken to organize a company. This was done by the appointment of Gardiner G. Hubbard as Trustee.

Anticipating such an outcome, and recognizing that

it would be wise definitely "to associate with them a practical mechanician of sufficient skill and ability, under Mr. Bell, to make these inventions pecuniarily successful," the three members of the "Bell Patent Association" had in the previous autumn made a contract with Thomas A. Watson, Bell's assistant. It was dated September 1, 1876. It provided that Watson should give at first half his time and later all his time to working on the patents. This was the beginning of the Bell System's research laboratories. In return Mr. Watson was to receive $3.00 a day as wages, and a one-tenth interest in all the patents when the joint stock company was organized. This provision was now carried out.

Mr. Watson's distinctive contribution was along the line of the developing of the invention. He had little to do with the organizing of the business. From the time of Bell's sailing for Europe in July, 1877, until his own resignation and departure for Europe in June, 1881, he carried the burden of the necessary research work and superintended the making of the telephone instruments. Though he had had no scientific education, and though indeed of technical training for that work there was at that time none to be had anywhere, he had to solve or try to solve all the baffling technical problems that arose in telephone construction and operation. Taking up the work of Alexander Graham Bell, his was a large share in the making of Bell's invention a practical thing with commercial possibilities, and in those four over-worked years started the remarkable record of Bell System engineers in the solving of telephone problems and the advancing of the art of telephony.

The title of the declaration by which Mr. Hubbard undertook the responsibility of the business affairs of the telephone was the Bell Telephone Company, Gardiner G. Hubbard, Trustee. It was dated July 9, 1877. At the same time, the members of the "Bell Patent Association" made an assignment of all their rights under the four patents to the Trustee. This brought what has here been

called the "Bell Patent Association" to an end and vested all the rights and powers of the three men in Mr. Hubbard's Trusteeship.

The Leasing of Telephones

The legacy of the Trusteeship to the Bell System was the leasing and licensing system. This led directly to the sale of service only, the fundamental principle of the business policy of the Bell System. Mr. Hubbard got the idea of leasing telephones instead of selling them from the practise of the Gordon-McKay Shoe Machinery Company, of which he was attorney. This company leased its shoe-sewing machines to the shoemakers, retaining the title to the machines and receiving a royalty for every pair of shoes sewed with the machines. Mr. Hubbard had the business control of the telephone in his own hands and adopted this method of distribution. The Declaration of Trust in its plan of organization provided for it and not for the sale of telephones, as follows:

> "The business of manufacturing telephones and licensing parties to use the same for a royalty, shall be carried on and managed by the Trustee, under the name of the Bell Telephone Company, under and in accordance with such general directions, rules and regulations as may be made for that purpose by the Board of Managers."

Against strong pressure from most of his associates, and in spite of sore need for money at a time when sales would undoubtedly have brought in a greater income than the leases, Mr. Hubbard firmly held to the leasing principle as the wisest and best for the development of the telephone business. Certainly the unity and the nation-wide efficiency of the Bell System would have been impossible if he had yielded and tried to build the business up on a sale basis. To some of those concerned it seemed absurdly impractical, but it resulted ultimately in the munificent endowment of the Bell System.

The Declaration of Trust also provided for the division of the rights into 5,000 equal shares. The contract with Mr. Watson required that he should receive a one-

tenth right. Mr. Bell married Mr. Hubbard's daughter on July 11, 1877, and at that time made over to his bride practically all his financial interest in the telephone patents with her father as trustee for her. Mr. Hubbard also wished to bring his wife and his brother into the telephone ownership to a moderate degree. Accordingly on August 1, 1877, the telephone rights were converted from the ownership by the three men into the form of 5,000 shares of stock, the shares were apportioned, and certificates were issued by Gardiner G. Hubbard, Trustee, as follows:

	Shares		Shares
Alexander Graham Bell	10	Thomas Sanders	1497
Mabel Gardiner Bell	1497	Thomas A. Watson	499
Gardiner G. Hubbard	1387	Charles Eustis Hubbard	10
Gertrude McC. Hubbard	100		
		Total	5000

But money was very scarce. Mr. Sanders personally was still supplying most of what was needed. He was gallantly staking his entire fortune and credit to see the telephone through to success. Indeed he put in $110,000 before he got a dollar back. Now again, when relief came to the finances of the telephone, it came through Mr. Sanders. He interested a group of Massachusetts and Rhode Island men. They agreed to put money into the telephone, but they wished to confine their interest and their responsibility to the development of the telephone within the territory of New England; and naturally, while willing to cooperate with the Trusteeship, they wished to control the telephone business within that territory.

The First New England Company

Accordingly the New England Telephone Company was formed. While there was no direct connection between this Company and the present New England Telephone & Telegraph Company, yet it is clear that the old New England Company pointed the way to the regional organization and federated relationships of the

Associated Companies in the Bell System. The subscribers to the Articles of Association were:

Gardiner G. Hubbard	C. S. Bradley	Edward Sherwin
Thomas Sanders	G. L. Bradley	Joseph H. Goodspeed
Thomas A. Watson	Alexander Cochrane	W. G. Saltonstall
Chas. Eustis Hubbard	Rowland Hazard	G. Z. Silsbee

The office of the corporation was to be in Boston, and the capitalization $200,000,—2,000 shares of $100 each. The Certificate of Incorporation was dated February 12, 1878. The officers chosen were:

President, Gardiner G. Hubbard	Clerk, Chas. Eustis Hubbard
Treasurer, Thomas Sanders	General Agent, G. L. Bradley

The Articles committed the Company to Mr. Hubbard's policy of leasing and not selling telephones. They simply declared the intention to constitute a corporation "for the purpose of carrying on the business of manufacturing and renting telephones and constructing lines of telegraph therefor, in the New England States." On February 2, 1878, before the Certificate of Incorporation was filed, Gardiner G. Hubbard as Trustee made an assignment to the New England Telephone Company, of all rights under the four patents for the territory of the New England States. He did this by an agreement to license in consideration of the payment of $1.00 and 1,000 shares, one-half of the stock, of the New England Telephone Company, to be issued: to Gardiner G. Hubbard, 600 shares; to Thomas Sanders, 300 shares; to Thomas A. Watson, 100 shares,—to each as trustee for the Bell Telephone Company. The agreement required that the New England Telephone Company buy its telephone instruments exclusively from the Bell Telephone Company at the price of $3.00 for telephones and $10.00 for magnetic calls, and specifically forbade the New England Company from selling the instruments, permitting them only to lease them to their subscribers.

The agreement further provided for cooperation between the Bell Telephone Company and the New England Company in conducting the telephone business within

and outside of the New England States, and in patent litigation. Finally, there was a specific provision in the agreement looking forward directly to the creation of the long lines:

> "And insomuch as said parties and their successors and assigns may have a common interest in the working of continuous and connecting lines extending outside of New England, the said parties agree that they will endeavor to cooperate in the establishing of connecting lines and in the joint working of the same, and the division of the expense and the profits thereof pro rata upon some equally fair and equitable basis."

It is interesting that the coordination of subscribers' lines began, with the opening of the first commercial telephone exchange at New Haven on January 28, 1878, only five days before this agreement for the coordination of exchanges by a long lines system was signed.

The Bell Telephone Company

The success of the New England Telephone Company in its territory suggested the advantage of a similar organization for the telephone business in the rest of the country. Money was needed; money could be secured from Mr. Sanders' friends on condition of such reorganization. Probably Mr. Vail, who accepted the position of General Manager in a letter dated May 22, 1878, also advised it as wise from the business point of view. Accordingly the Bell Telephone Company was formed.

This was not an incorporation of the Trusteeship, but an entirely new and different organization. The men who signed the Agreement of Association on June 29, 1878, to form the new Company were:

Gardiner G. Hubbard	Chas. Eustis Hubbard	Thomas B. Bailey
Thomas Sanders	Thomas A. Watson	James Sturgis
Alex. Graham Bell (by Atty. G. G. H.)	A. O. Morgan	Joseph H. Goodspeed
	George L. Bradley	

The officers elected were:

President, Gardiner G. Hubbard	Clerk, Chas. Eustis Hubbard
Treasurer, Thomas Sanders	Gen. Mgr., Theodore N. Vail

The office was located in Boston, and the capitalization

was $450,000, 4,500 shares of $100 par each. The Certificate of Incorporation was filed on July 30, 1878.

While there was actually no divergence from Mr. Hubbard's business policy of only leasing telephones, the new Company took to itself the right to sell the instruments by the following clause in the Articles of Association:

> "The purpose for which the Corporation is constituted is to manufacture and sell telephones and their appurtenances and to construct, maintain and operate telephone lines and rent telephones throughout the United States outside of the New England States."

After this one glance in the tempting direction of sales, however, the policy of only leasing was maintained and unhesitatingly continued thenceforth.

In effecting the transfer of the control of the telephone to the new company, on July 20, 1878, Gardiner G. Hubbard as Trustee made an assignment to the Bell Telephone Company of "all the patents, patent rights and interest in any and all contracts relating to any patents or future inventions owned or held by him as Trustee," in return for 3,000 shares of the capital stock of the new Company; and also sold to the new Company all other property of every kind and description for $42,500.

The actual control and real direction of the telephone industry therewith passed into the hands of an Executive Committee of the Bell Telephone Company, consisting of Gardiner G. Hubbard, Thomas Sanders and George L. Bradley, for whose authority the Directors provided by the following resolution:

> "That the Executive Committee shall, until further orders, have all such powers as may be necessary for the management of the Company."

About the same time the differentiation of the two Companies was emphasized by a change in the officers of the New England Telephone Company. Mr. Hubbard and Mr. Sanders resigned as President and Treasurer on July 27, 1878, and their places were filled as follows:

President, Thomas Sanders Treasurer, George L. Bradley

Thus came to an end the Bell Telephone Company, Gardiner G. Hubbard, Trustee. Mr. Hubbard's exclusive control of the business affairs of the telephone had rendered its great service. It was with the endowment of the right business policy that the telephone went on to its next step toward the federated system of the American Telephone and Telegraph Company and its Associated Companies of the present.

Uniting Telephone Interests

On December 31, 1878, a new name appeared in telephone affairs. William H. Forbes was on that day elected a Director of the Bell Telephone Company. The telephone was now well launched into the period of patent litigation. Its prosperity had suffered from the superiority of the Edison transmitter, but now the Blake transmitter was brought to the Company by its inventor, and the advantage in the competition for the control of telephone service was restored to the Bell interests. Francis Blake, Jr., also was elected to the Board of Directors at the same meeting as Mr. Forbes. Within a month Mr. Sanders resigned as Treasurer of the Bell Telephone Company and George L. Bradley was elected to succeed him.

The opportunity which lay in the situation as a whole called for the strongest and most able business ability in the community. This was secured in the person of Mr. Forbes and the interests he represented. In effect this amounted to his taking over control of the telephone, for at a meeting of the stockholders on January 23, 1879, a by-law was passed providing that—

> "The holders of one-third of the stock for which money has been paid and subscribed shall, for the space of two years, have an equal right and power with the holders of the two-thirds reserved to the patentees; and any holders of such originally subscribed stock shall cast two votes at each meeting upon each of such shares, and the holders of the stock originally issued to the patentees shall cast one vote on each of such shares during said two years."

This unquestionably placed the control of the Company's affairs in the hands of Mr. Forbes and those who were supplying the new money.

The National Bell Telephone Company

Mr. Forbes immediately, at a meeting of the Directors on January 29, 1879, took steps toward uniting all the Bell interests in one Company, the National Bell Telephone Company. The Articles of Association were signed on February 17, 1879, by the following men:

Gardiner G. Hubbard	Thomas B. Bailey	G. Z. Silsbee
Francis Blake, Jr.	R. W. Devonshire	Alex. Cochrane
Thomas Sanders	William H. Forbes	J. Cheever Fuller
George L. Bradley	Charles S. Bradley	C. E. Hubbard
Richard S. Fay	Alexander Graham Bell	

The purpose was stated in the Articles of Association as follows:

> "To manufacture, sell and rent telephones and their appurtenances, and to build, maintain and operate lines for the transmission of messages by electricity or otherwise."

The office was to be located in Boston, and the capitalization was to be $850,000, 8,500 shares of $100 par each. The following officers were elected:

President, William H. Forbes Treasurer, George L. Bradley
Clerk, Chas. Eustis Hubbard Gen. Mgr., Theodore N. Vail
Electrician, Alexander Graham Bell

The Executive Committee consisted of the President of the new National Bell Telephone Company, the Presidents of the two constituent Companies, and two of the new men:—William H. Forbes, Gardiner G. Hubbard, Thomas Sanders, Richard S. Fay, and Francis Blake, Jr. The Certificate of Incorporation was filed on March 13, 1879.

Of the $850,000 of the stock of the new Company, $200,000 was paid to the New England Telephone Company to distribute to its shareholders share for share; $450,000 was paid to the Bel Telephone Company to distribute to its shareholders share for share; $75,000 was

assigned to the money-paid or money-subscribed stockholders of the Bell Telephone Company on the 2 votes to a share basis; and $125,000 was held as Treasury stock.

On March 20, 1879, both the New England Telephone Company and the Bell Telephone Company made assignments of their rights under two of the Bell patents, Nos. 161,739 and 178,399, to the National Bell Telephone Company; but they specifically excepted from their assignments the two distinctively telephone patents, Nos. 174,465 and 186,787. The National Bell Telephone Company never acquired title to these two patents during the life of the corporation.

Thus were the two former Companies consolidated. Thus was the development of the telephone and its introduction throughout the country unified by the organization of the National Bell Telephone Company under William H. Forbes. The name was an appropriate one. It was at this time that the Telephone entered into its truly national career, and its industrial development was dominated and chiefly directed by two men. William H. Forbes represented the East,—the East of the East,—with its conservative stability and its regard for tradition and social and financial standing. The telephone had scored as something to be permanently reckoned with when it secured a Forbes of Boston as its President. Theodore N. Vail represented the West with its direct freedom and disregard for anything but inherent merit. Although Vail was born in the East, the West had breathed the breath of its life into him and made him her own. Both individually and both in cooperation were essential at this time to the development of the telephone into a truly national utility and institution.

The National Bell Telephone Company had unified the development of the telephone, but it concerned affairs only inside the household, so to speak. It brought the family in under one roof, but the roof was not large enough to permit of very much increase in the size of the family. The pressure of affairs outside the Bell Telephone

household was within a year to render the National Bell Telephone Company quite inadequate to cope with the situation as a whole.

Coordination of Local Companies

In the spread of the telephone over the country the method of local organization had usually been by means of local corporations which leased their instruments from the parent company. But if the telephone service was to be unified, which was becoming more and more evidently essential, the mere leasing of instruments would not be sufficient for a real coordination of the local interests with other local companies and with the parent company, even though this was before the days of the long lines connecting the various local city exchanges.

Further, there were rival telephone companies springing up to prey on the opportunity. To keep the local telephone companies from falling into the hands of these rival corporations by a transfer of a majority of their stock, it was not enough for the National Bell Telephone Company to lease the instruments. It must license the local companies exclusively. More than that, it must gain control of those companies by purchasing a sufficient proportion of their stock. This necessitated the command of a large amount of capital, far more than enough for the parent company to conduct its own regular business. The $850,000 which in March, 1879, had been deemed ample, by March, 1880, had proved to be utterly inadequate.

In this situation the most serious competitor was the powerful Western Union Telegraph Company. During the early summer of 1879 the Western Union made it a matter of policy to buy up controlling interests in the companies organized under Bell licenses. The fight with the Western Union and the enormous increase of business which came with the settlement of that fight on November 10, 1879, on the basis of all telephone business going to the National Bell Telephone Company and all telegraph

business to the Western Union Telegraph Company, constituted the most important single element that made it necessary to reorganize the telephone business.

In order to permit this reorganization on an adequate scale and to permit the corporation to hold stock in other corporations, the Massachusetts Legislature passed a special act giving authority for the purpose, and it was signed by Governor John D. Long on March 19, 1880. The purpose as stated in this Act was for the

> "manufacturing, owning, selling, using and licensing others to use electric speaking telephones and other apparatus and appliances pertaining to the transmission of intelligence by electricity, and for that purpose constructing and maintaining by itself and its licensees public and private lines and district exchanges."

The capitalization was limited to $10,000,000, and the permission to hold stock in other corporations was conditioned as follows:

> "Said corporation may become a stockholder in or become interested with other corporations hereafter organized for like purposes, or already established for the transaction of telephone business under its patents and no others: Provided, that said corporation shall not become a stockholder in any other corporation doing business in this state to an amount exceeding 30% of the capital stock of said last named corporation."

The American Bell Telephone Company

In accordance with this Act of Legislature, The American Bell Telephone Company was formed on March 20, 1880, by an Agreement of Association signed by the following men:

William H. Forbes	Charles Emerson	R. W. Devonshire
G. Z. Silsbee	George L. Bradley	Thomas B. Bailey
Francis Blake	Chas. Eustis Hubbard	C. M. Whitcomb
Richard S. Fay	W. G. Saltonstall	

The officers chosen were as follows:

President, William H. Forbes	Treasurer, W. R. Driver
Clerk, Chas. Eustis Hubbard	Gen. Mgr., Theodore N. Vail
Engineer, Joseph P. Davis	Supt. of Agencies, O. E. Madden

Consulting Engineers: Alexander Graham Bell and Francis Blake
General Inspector, Thomas A. Watson

The capitalization was fixed at $7,350,000, 73,500 shares of $100 par each, and the office was to be in Boston. The Certificate of Incorporation was filed on April 17, 1880.

The purchase by the American Bell Telephone Company of the stock of the National Bell Telephone Company was duly effected by payment of 6 shares of the new stock for 1 share of the old. This took up $6,500,000 of the American Bell stock. The balance of $850,000 was offered to the stockholders of the National Bell Telephone Company at par.

In order beyond any legal question to put into the hands of the new corporation all patent rights belonging to the Bell interests, assignments were made and licenses issued to the American Bell Telephone Company by all parties having any shadow of right or of ownership. Four of these were made in May and June, 1880; two more about a year later, in 1881; and even in 1885 confirmatory assignments were made to the American Bell Telephone Company by Alexander Graham Bell, and by Gardiner G. Hubbard, Trustee, and seven others.

The Exchange System, coordinating any number of telephone subscribers' lines, was by this time well established in permanent practise. From the engineering point of view this was the great achievement of the National Bell Telephone Company. The next problem to arise was to connect those exchanges—the problem of the Long Lines System. The first step in this direction was made on June 2, 1880, when the Directors of the American Bell Telephone Company authorized contract for building a telephone line from Boston to New York. This line was opened on March 27, 1884. On May 9, 1883, the Directors authorized the building of long distance lines between Boston, New York, Philadelphia and Washington, and between New York and Albany. The creation of the Long Lines System was to be the great achievement

of the American Bell Telephone Company, although it had to be done in an indirect way, by the formation of a special company for the purpose.

The maximum capitalization allowed the American Bell Telephone Company by the Act of the Massachusetts Legislature of March 20, 1880—$10,000,000—was quite inadequate for the development of the business and the construction of lines on so large a scale as was rapidly becoming necessary for rendering a nation-wide service. In 1884 application was made to the Massachusetts Legislature for permission to increase the capital stock of the American Bell Telephone Company to $30,000,000 in order to provide for these needs, but permission was refused.

The American Telephone & Telegraph Company

Accordingly a new company was organized for the particular purpose of building long lines connecting the city exchanges, and incorporation was sought in another state. This was the American Telephone and Telegraph Company, chartered under the laws of the State of New York. The Articles of Association were signed on February 28, 1885, by Edward J. Hall, Jr., Thomas B. Doolittle, Joseph P. Davis and Amzi S. Dodd. The capitalization was $100,000, of which each of the associators owned a fourth. The purpose was stated with almost exhaustive precision, to construct and operate lines all over the North American continent, not only in the United States but in Canada and Mexico, "and also by cable and other appropriate means with the rest of the known world." For the first fourteen years of its existence the American Telephone and Telegraph Company was distinctively the Telephone Company of the Long Lines.

Theodore N. Vail became the first President of the American Telephone and Telegraph Company, with Edward J. Hall, Jr., as General Manager and Angus S.

Hibbard as General Superintendent. Under their management the Long Lines System grew rapidly and became more and more important in telephone affairs. On September 17, 1887, Mr. Vail resigned the Presidency and Edward J. Hall, Jr., took his place. The growth continued.

Meantime Mr. Forbes continued as President of the American Bell Telephone Company until 1887, when he resigned. On August 10, 1887, Howard Stockton was elected President and took office on September 1st following. He in turn was succeeded on April 1, 1889, by John E. Hudson.

By 1899 it was deemed best that the American Telephone and Telegraph Company should be made the central organization. Experience had proved that conditions under the laws of the State of New York were more advantageous for the development of so great an industry as this promised to be than under the laws of the Commonwealth of Massachusetts. Increases of capitalization were allowed by the Massachusetts Legislature, in 1889 to $20,000,000, and in 1894 to $50,000,000, but these increases were not adequate in either case to the needs of the business which almost immediately thereafter loomed up before the company. Furthermore, with the increase of 1894 the Legislature imposed the restrictions that the new stock must be offered to stockholders, not at par, but at a market price to be fixed by the Commissioner of Corporations, and that stock remaining after that offer should be sold at auction. These were conditions which were not practical for a business of national scope. Accordingly, on December 1, 1899, the Directors of the American Bell Telephone Company voted to convey all their assets, both in stock and property, to the American Telephone and Telegraph Company in return for stock at the rate of two shares of American Telephone and Telegraph stock for one of American Bell Telephone stock. The reason for this proportion was that the value of the assets of the Ameri-

can Bell Telephone Company in this transaction was more than twice as great as the stock which represented it.

The establishment of the American Telephone and Telegraph Company as the central organization of the telephone resulted in the succeeding years and especially during the Presidency of Frederick P. Fish, from 1901 to 1907, in greatly increased development work. The telephone spread rapidly throughout the country. This, however, is another story, which does not belong to the period of the Early Corporate Development of the Telephone. Through this strenuous period of the rise of the trusts in American industry, the Telephone progressed, through competition to cooperation in the second administration of Theodore N. Vail. He federated the various telephone companies into the present Bell System. This ushered in the present period of enormous achievement, with which has come increasingly the realization of the three-fold ideal of One Policy, One System, and Universal Service.

WILLIAM CHAUNCY LANGDON.

(Note:—Mr. Langdon is with the Information Department of the American Telephone and Telegraph Company in charge of the Historical Collection—*Editor*.)

The Missouri Rate Case

THE decision of the United States Supreme Court rendered in the Southwestern Bell Telephone Company case on May 21, 1923, is of especial interest to the Bell System.

The facts out of which the case arose were as follows:

Immediately after the termination of federal control, the Commission made an order directing the Southwestern Company to show cause why the rates for exchange service and the charges for installation and moving fixed by the Postmaster General should not be reduced. In response to this order, the company made its showing. After a hearing the Commission ordered a reduction in the exchange rates and a discontinuance of the installation and moving charges.

The company took an appeal which, under the Missouri practice, went first to the Cole County Circuit Court and from it to the Supreme Court of Missouri, each court affirming the order of the Commission. Thereupon, the case was taken to the Supreme Court of the United States. That court reversed it. The majority opinion discusses two questions:

In the first place, it holds that a consideration of the greatly enhanced present costs of material, labor, supplies, etc., is essential to an honest and intelligent forecast of probable future values made upon a view of all the relevant circumstances. It finds that the Commission accorded no weight to these factors and therefore concludes that its valuation was not properly made. It should be noted that the court does not decide that present costs constitute a measure of value, or that they are the only factors to be taken into account in determining it. It only decides that these factors must be considered, so that a valuation which ignores them is not legally made. This accords with the court's earlier decisions upon this question.

The second point as to which the court finds that the

Commission was wrong is the disallowance of 55 per cent of the license contract payment. The court holds that in the absence of bad faith, or something to indicate an improper exercise of its discretion by the board of directors, whether this contract should be made and its terms, including the amount of the payment, are matters of business management within the jurisdiction of the directors and outside of the scope of regulation. In this connection the court says:

> "Four and one-half per cent is the ordinary charge paid voluntarily by local companies of the general system. There is nothing to indicate bad faith. So far as appears, plaintiff in error's board of directors has exercised a proper discretion about this matter requiring business judgment. It must never be forgotten that while the State may regulate with a view to enforcing reasonable rates and charges, it is not the owner of the property of public utility companies and is not clothed with the general power of management incident to ownership. The applicable general rule is well expressed in *State Public Utilities Commission ex rel. Springfield vs. Springfield Gas and Electric Company*, 291 Ill. 209, 234.
>
> " 'The Commission is not the financial manager of the corporation and it is not empowered to substitute its judgment for that of the directors of the corporation; nor can it ignore items charged by the utility as operating expenses unless there is an abuse of discretion in that regard by the corporate officers.' "

The opinion may be accepted as setting at rest these two important propositions.

It is a matter of interest that twenty-five years ago Mr. William Jennings Bryan, appearing for the Nebraska Commission, urged in the Supreme Court that present costs were the criterion fixing value, while on behalf of the railroad companies to which he was opposed in that case it was contended that original cost should be the basis. The court held that each of these factors, as well as all other material factors, must be taken into account. The parties aligned themselves in accordance with what each deemed to be its interest. Then reproduction cost was less than original cost. When this reversed itself the parties promptly reversed their positions.

In the Southwestern Company's case the court was unanimous in the conclusion that the case should be reversed because the rates established by the Missouri Commission were confiscatory. Mr. Justice Brandeis, however, with whom Mr. Justice Holmes concurred, filed a dissenting opinion. The argument of the dissenting opinion is that because of the difficulty in definitely fixing value and what is a fair rate of return, in lieu of these factors there should be substituted the amount prudently invested and the amount of the capital charge. It says:

> "The adoption of the amount prudently invested as the rate base and the amount of the capital charge as the measure of the rate of return would give definiteness to these two factors involved in rate controversies which are now shifting and treacherous, and which render the proceedings peculiarly burdensome and largely futile. Such measures offer a basis for decision which is certain and stable."

At another place it says:

> "The prime needs of the community are that facilities be ample and that rates be as low and as stable as possible. The community can get cheap service from private companies, only through cheap capital. It can get efficient service, only if managers of the utility are free to devote themselves to problems of operation and of development. It can get ample service through private companies, only if investors may be assured of receiving continuously a fair return upon the investment."

The dissenting opinion also comments upon the fact that there is a distinction between a reasonable rate and a rate that is merely compensatory, stating the established doctrine that under reasonable rates fixed by public authority an efficiently managed utility may earn much more than a mere fair return. It very aptly states that what the Constitution guarantees to the utility is not a fair return but only the opportunity to earn a fair return.

A significant thing in the dissenting opinion which should receive the most careful consideration is the reference to the fact that the present fair value and

present fair return rule of the majority opinion is a rule that may work both ways. It is said:

> "To require that reproduction cost at the date of the rate hearing be given weight in fixing the rate base, may subject investors to heavy losses when the high war and post-war price levels pass—and the price trend is again downward."

Again, upon the matter of fair return, it proceeds:

> "The necessary cost, and hence the capital charge, of the money embarked recently in utilities, and of that which may be invested in the near future, may be more, as it may be less, than the prevailing rate of return required to induce capital to enter upon like enterprises at the time of a rate hearing ten years hence."

This justifies the greatest emphasis upon the necessity for care and economy in the present construction of plant. Long-time financing is absolutely necessary, and it, too, must have the same careful consideration.

N. T. GUERNSEY.

NOTE: *Since the above was written, the United States Supreme Court, on June 11, 1923, filed its opinion in Bluefield Water Works and Improvement Company vs. Public Service Commission of the State of West Virginia et al., in which it reaffirms the decision in the Southwestern Bell Company case. It holds that it was error to disregard the cost of reproduction at current prices as a factor affecting value, citing the Southwestern Bell Company case in support of this conclusion.*

On the same day in Georgia Railway and Power Company et al. vs. Railroad Commission of Georgia et al., the court refused to reverse a case where it found that the cost of reproduction had been considered as a factor in fixing value, but had not been closely followed. This case, with the Southwestern Bell Company case and the Bluefield Water Works and Improvement Company case, sharply brings out the fact that while the cost of reproduction is a factor that must be taken into account, it does not furnish an arbitrary measure of the value of a utility.

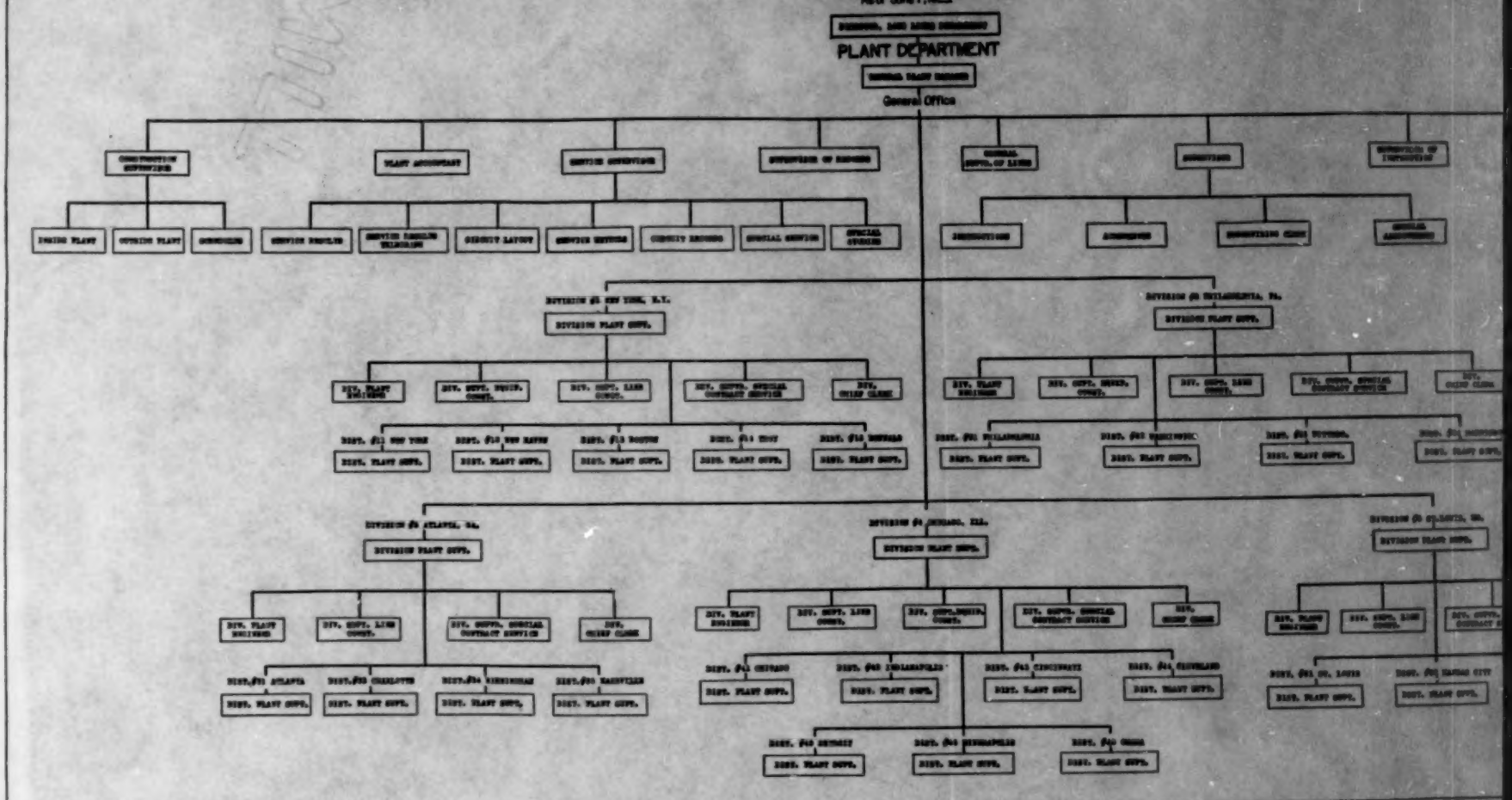
N. T. G.

WAR RECORD BOARD

LONG LINES DEPARTMENT
OF
AMERICAN TELEPHONE & TELEGRAPH CO.

ORGANIZATION DIAGRAM OF THE PLANT DEPARTMENT

As of June 1, 1923.



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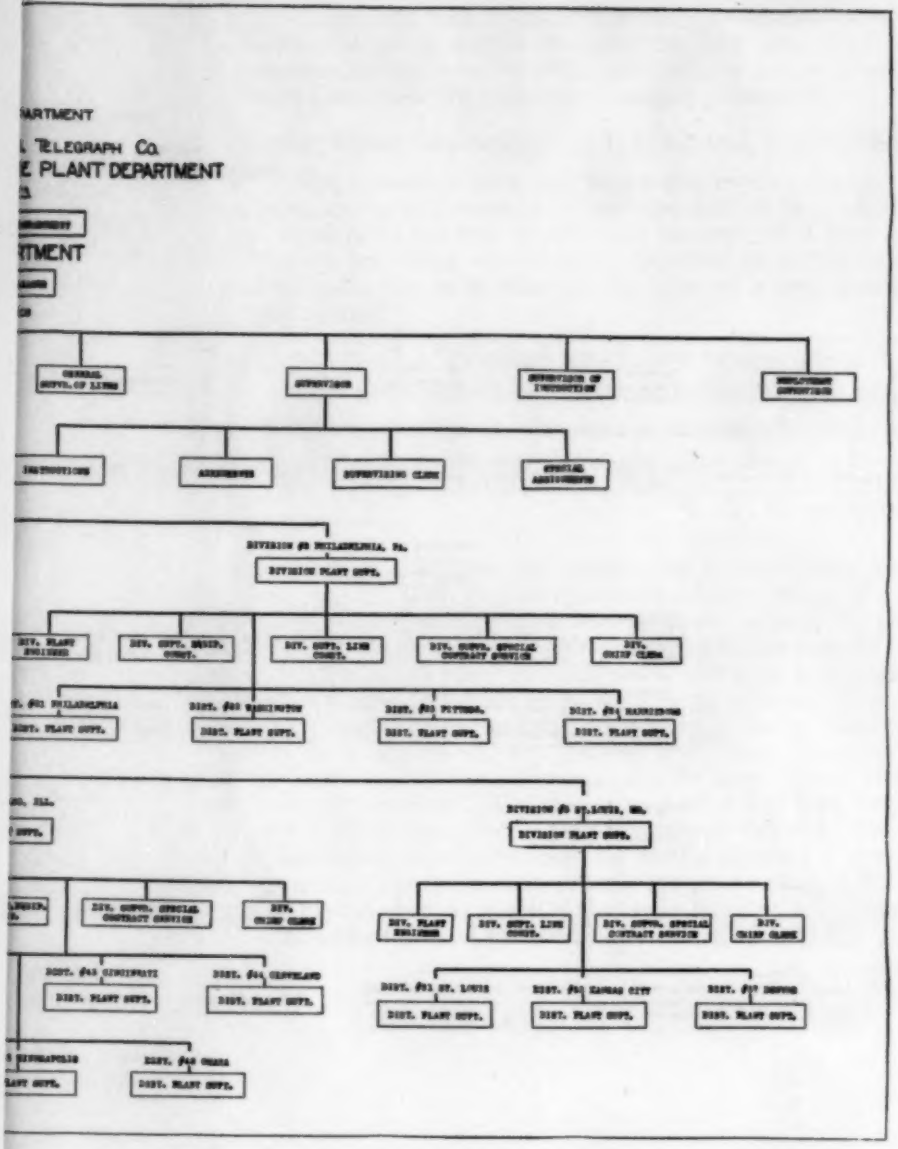

The Work of the Long Lines Plant Department

WHEN a man in New York puts in a call for Chicago, Omaha, or San Francisco, he does not know or care about sleet storms in Illinois which may have shattered the telephone lines. When a man in San Francisco buys an evening paper he may want to get the closing prices on the New York Stock Exchange, or he may want the results from the baseball games at various eastern cities. There may be a flood at Pueblo or a cyclone at Omaha, but he is not interested in anything that they may be doing to the transcontinental lines. His sole interest in such events, if he has any, is as news items, and he seldom appreciates that the very fact that they have happened may be causing delay in his hearing about them, as well as delay in the transmission of other news. The Long Lines plant, existing for the sole purpose of furnishing means of communication between distant points in the United States and between the United States and points in Canada and Cuba is something which these men know very little about, but which is constantly serving them and thousands of other individuals.

In his address before the National Association of Railway and Utilities Commissioners at Detroit, in November, 1922, Mr. H. B. Thayer made the following statements:

> The license contract between the American Telephone and Telegraph Company and the Associated Companies was intended to afford, and has afforded, the basis absolutely essential to a national telephone system. Aside from all questions of economy and efficiency, a national universal service could not be provided at all by a large number of uncoordinated local units. * * * It includes the obligation on the part of the American Company to construct, operate and extend the long distance lines connecting the various companies into an harmonious national operating unit. * * * Logical operating divisions are not bounded by state lines. A division between national and sectional toll lines cannot follow state lines. The undertaking

> by the national organization to construct, maintain and extend the long lines is not a device for taking away from the state organizations the cream of the toll business. The long lines form one part of the national machine, designed to handle such long distance service as may be most efficiently and economically provided through this means, and so designed to make the national machine as a whole operate most efficiently and economically.

These statements define the function of the Long Lines Department in the Bell System. Within the Long Lines Department, the function of the Plant Department is the responsibility for the construction and the maintenance of the Long Lines plant, and for the operation of the special contract telegraph and telephone service. Over its circuits in 1922 passed nearly 28,000,000 long distance telephone conversations and approximately ninety per cent. of the special contract telegraph service used by press associations, newspapers, banks, brokers, manufacturers, departments of the United States Government, and business houses.

To handle these communications there are about four thousand telephone circuits and about one thousand telegraph circuits. Most of these circuits terminate in different states, many of them extend through a number of states, and some of them extend from the Atlantic to the Pacific coast. Each is an electrical circuit full of complicated equipment and requiring the most exact electrical adjustments to operate satisfactorily. From day to day, in spite of sleet storms, cyclones, fires, as well as the more numerous minor difficulties, these circuits must be kept in operation throughout the entire system if the Long Lines customers are to be satisfied and the plant is to serve the purpose for which it was constructed.

The construction problems are important and interesting, but the most important job of the Plant Department employees is to keep the plant working, i.e., maintain the service. About 4,100 times a month something happens to a wire which prevents the circuit or circuits of

which that wire forms a part from working. About 1,800 times a month something happens to one of the innumerable pieces of equipment in the circuits which prevents the circuit or circuits of which that equipment is a part from operating. These are called line and equipment troubles, respectively, and must be cleared as promptly as possible to reduce the lost circuit time. Trouble clearing, while important, is only a small part of the maintenance work. Inspections and repairs for preventing and reducing service trouble rank ahead of trouble clearing and closely allied with them is the constant work of improving the transmission efficiency of the circuits.

The plant and equipment, involving an investment of more than $110,000,000, extends over thirty-five states, and plans for 1923 construction work contemplate extensions into three additional states. It consists of approximately 1,115,000 miles of wire including both open wires and wires in cables, with the necessary supporting structures for the open wires and cables, and of equipment for making available for service, operating, and testing the various types of telephone and telegraph circuits which are used in the Long Lines service. More than 27,000 miles of pole line, involving nearly 1,200,000 poles, support the open wires and the aerial cables and there are 867 miles of underground conduit for carrying the underground cables. Coils and circuit arrangements have made available 235,000 miles of phantom telephone circuits and loading coils have been installed on 396,000 miles of telephone circuits. Some of the principal items of equipment are:

1,608 sections of toll switchboard
384 sections of testboard
196 sections of Morseboard
2,485 telephone repeaters
19 telephone carrier current channels
112 telegraph carrier current channels
3,790 polar duplex telegraph sets
635 metallic telegraph sets
349 printing telegraph sets

The maintenance work is continuous, exacting, and because the service furnished is dependent on it, is highly important. For those reasons the District organization of the Plant Department is designed primarily to meet the service maintenance requirements and the construction work is concentrated in the five Division organizations, thereby giving each Division sufficient work to justify permanent gang organizations and allow for flexible and economical scheduling of jobs. The average length of the Long Lines circuits is so great and the investment per circuit so high that circuits in trouble mean substantial losses in revenue. For that reason the organization of the Long Lines Plant Department is set up on the basis that it is justified in maintaining the plant at the highest degree of efficiency, doing most intensive trouble prevention work and everything possible to clear troubles which cannot be prevented as rapidly as possible, thereby reducing the lost circuit time to a minimum.

The length and the complicated types of telephone and telegraph circuits operated by the Long Lines bring about the necessity for complete coordination of work and cooperation between the forces in the different territories and testrooms. Each telephone and telegraph circuit is controlled by one testroom which is known as the control office, and that office is responsible for service on the circuit. Restoration of service on any one circuit frequently involves employees in more than one Division and several Districts. To get satisfactory results they must all work together. This requires careful supervision in the handling of work and close supervision of the results obtained.

There are approximately 4,900 employees in the Department. The territory is divided into five Divisions, each in charge of a Division Plant Superintendent. The Division headquarters are located at New York, Philadelphia, Atlanta, Chicago, and St. Louis. The Divisions are further sub-divided into twenty-one Districts, each in charge of a District Plant Superintendent. While

there are no formal sub-divisions within the District, nearly all of the Districts have more than one testroom, each of which is in charge of a Chief Testboard Man, who directs the testing, the maintenance work of the section linemen and cablemen on the lines tested, and the operation of the special contract service. The equipment work in each of the larger offices is in charge of a Chief Equipment Man, who likewise reports to the District Plant Superintendent.

The District Plant Superintendent's work is distinctly a service job. He is responsible for the routine maintenance of the plant in his District and for the operation of the special contract service handled in his testrooms. Routine maintenance includes all maintenance except the pole replacement inspections which are handled by the Division offices, the pole replacement work done as a result of such inspections, which is handled by the Division gangs in connection with the construction work, and such repairs due to storms or accidental damage as are of sufficient magnitude to require the service of the Division gangs. It, of course, involves keeping the plant in his District available for service and responsibility for the transmission efficiency of the circuits controlled by the testrooms in his District.

He has a staff consisting of a Chief Clerk, a District Line Inspector, and a District Inspector, the latter being a technically trained man who assists him in supervising the maintenance work, particularly with reference to the transmission testing and the transmission efficieney of the circuits, and in handling negotiations with electric light and power companies where technical knowledge is required.

As far as possible the District Superintendent is relieved of all responsibility for construction work in order that he can devote his entire time to things which directly affect service. He is, however, expected to make recommendations for changes in plant conditions to reduce hazards and improve service conditions. He is also fre-

quently called upon by the engineers to get information needed to plan additional facilities, which he can obtain more economically than the engineers could. He also keeps in touch with road building, construction of trolley lines, electric light and power lines, and other activities which jeopardize the plant.

The open wire plant is maintained by approximately 310 section linemen. The average section consists of about ninety miles of pole line, and 1,800 miles of Long Lines wire. Most of the Associated Company wire on the Long Lines plant is also maintained by the Long Lines section linemen in connection with their own work. Similarly on Associated Company pole lines their linemen maintain Long Lines wires. With the exception of the replacement inspection of poles and the heavy replacement work done by the Division gangs, each section lineman is responsible for all maintenance work in his section and for the condition of his line. He clears line troubles under the direction of the testboard men. Each section lineman makes regular repair trips over his section at intervals depending upon the importance of the line and its exposure to severe weather conditions. On these repair trips he cuts underbrush, trims trees, cuts down dangerous trees, replaces occasional broken poles and crossarms, replaces broken pins, insulators and tie wires, and pulls up slack wire. He also reports unauthorized attachments, encroachments by electric light and power companies, prospective road work which may endanger the line or require its relocation, and any other conditions which might be considered a hazard to the line or interfere with its efficient operation. If property owners refuse to permit cutting down or trimming trees which affect the insulation, he reports such conditions so that the Legal Department may arrange for the necessary trimming rights.

On the aerial cable lines section cablemen have been placed who patrol the lines and do the routine mainte-

nance work very much in the same way that the section linemen maintain the open wire lines.

Only a few years ago Company-owned horses or livery teams were used on all trouble clearing and maintenance work, but motor vehicles have superseded horses on all Long Lines plant work. All of the section linemen and cablemen are furnished with motor vehicles for use in trouble clearing and for transporting themselves and their helpers and material to and from work. The motor vehicle equipment furnished for use on maintenance work consists of:

246 light runabouts fitted with boxes on the rear
19 light touring cars used for supervisory purposes
47 ¾-ton trucks
33 1-ton trucks
7 gasoline railway speed cars

There are 380 equipment attendants reporting to Chief Equipment Men who maintain the switchboards, testboards, telephone repeaters, telegraph apparatus and other equipment. Routine tests on the various pieces of equipment are made at stated intervals and everything possible is done to keep equipment troubles from developing in service. Such troubles as do develop in service are cleared promptly.

In the testrooms, under the direction of the Chief Testboard Man, there are two large groups of employees, testboard men and telegraph repeater attendants. Testboard men make the routine morning wire tests, locate the wire troubles developed on tests or reported by the Traffic Department, and direct the movements of the section linemen who clear the troubles. They also keep track of the movements of the section linemen when they are out on repair work under the direction of the District Line Inspector, in order that instructions can be given them promptly and that they can be used for clearing troubles that may occur. Testboard men also make the routine insulation tests and resistance measurements.

The extensive use of telephone repeaters in the long distance circuits, the development of complicated cable circuits, and the introduction of carrier current telephone and telegraph circuits, all of which has taken place within the last few years, made necessary better maintenance and finer adjustments, which brought about the need for more efficient testing apparatus. This was met by the development of transmission measuring desks which have been installed in many of the testrooms. These desks permit the measurement of the actual transmission efficiency of the different circuits. Without them it would be difficult, if not impossible, to maintain satisfactory service over many of the circuits in use in the plant at the present time. Eighty-five per cent. of all of the Long Lines circuits, including all of the more complicated circuits, are now being measured regularly at transmission measuring desks.

The transmission testers who operate the transmission desks report to the Chief Testboard Man and the faults which they find in the circuits are located and cleared by his forces. The District Inspector, however, supervises their work closely and checks up the results from time to time.

The telegraph repeater attendants establish the special contract telegraph service through the different testrooms, maintain its continuity, take care of adjustments of the apparatus necessary to provide this service, and deal with the customers' operators in the regulating of the Morse signals passing over these circuits.

The Division Plant Superintendent, in addition to his responsibility for the work handled in his Districts, is also responsible for constructing the additions to plant in his Division, and such of the field engineering as is handled by the Plant Department. He is also directly responsible for the strength of the pole line structures, involving pole replacement inspections and the work found necessary as a result of such inspections. Each of the Division Plant Superintendents has a staff con-

sisting of a Division Plant Engineer, a Division Superintendent of Line Construction, a Division Supervisor of Special Contract Service, and a Division Chief Clerk. The three larger Divisions also have Division Superintendents of Equipment Construction, but in the two smaller Divisions equipment construction work is handled by the Division Plant Engineer.

The work of the Division Plant Engineer supplements the work done by the Engineer in New York. His force writes specifications for many of the construction jobs and in other cases obtains information for the Long Lines Engineering Department for use in engineering studies and in writing specifications prepared in New York. All estimates for construction, pole replacement, and break repairs are made up by the Division Engineer's force and submitted by the Division Plant Superintendent to the General Office for approval before material is ordered or work undertaken.

The Division Plant Engineer also prepares schedules for work based on the requirements of the Traffic Department or the order of importance as furnished by the Long Lines Engineer, keeps track of such schedules, and as far as his Division is concerned, under instructions from the General Plant Office, coordinates all of the construction work so that all of the different jobs necessary to complete a project may be available at the proper time. The Division Plant Engineer also assists the Division Plant Superintendent in the supervision of the maintenance work and in handling matters relating to electrolysis and inductive coordination.

The Division Chief Clerk handles the routine clerical work and is responsible for the plant accounting work done in the Division Office.

The Division Supervisor of Special Contract Service supervises the quality of service furnished the special contracts passing through his Division and keeps the Division Superintendent informed as to the quality of such service. He assists the different testrooms on

questions of improvements in this service and on certain questions of personnel. He also analyzes the different reports pertaining to message circuit troubles and poor transmission complaints on the message traffic.

The Division Construction Superintendent is responsible for handling the greater part of the additions to plant, and in connection with joint projects handles certain additions to the plant of the Associated Companies. In all of the long toll cables the Associated Companies have substantial interests. Some of this work is done by the Associated Companies and a considerable portion of the equipment construction work is done by the Western Electric Company. All of the larger new offices and all switchboard additions involving pneumatic tube work are handled by that Company.

During 1922 expenditures for gross additions to plant amounted to approximately nine and a quarter million dollars. The 1923 Provisional Estimate indicates expenditures for gross additions to plant of over thirteen million dollars. At the present time the construction force includes approximately 1,270 men. There are 67 line gangs, 5 cable gangs, 2 conduit gangs, and 31 equipment gangs. The 1923 construction program will require 48,500 poles, 178,000 crossarms, and over seven million pounds of bare copper wire.

The following motor vehicle equipment is in use by the construction forces:

66 light runabouts with box bodies
13 light touring cars for supervisory work
2 ¾-ton trucks
3 1-ton trucks
13 2-ton trucks
44 2½-ton trucks
5 3-ton trucks
12 3½-ton trucks
2 light tractors
3 caterpillar tractors
2 earth boring machines

In the General Office of the Plant Department it has always been the policy to put out to the field all of the

work and all of the responsibility that possibly can be delegated and to maintain a small, high-grade supervisory staff.

It is not within the scope of this article to go into detail about the work of the General Office in so far as it relates to the supervision of activities for which the field forces are directly responsible. The type and extent of the Long Lines plant and the coordination of the plant facilities in the different Divisions, as well as their coordination with the plant facilities of all of the Associated Companies to form an efficient and economical national system of toll lines, make it desirable to concentrate certain work in the General Office. This work is in connection with the methods of providing the additional facilities and the best utilization of the existing facilities, and involves work by the other general offices of the Long Lines Department.

In the Plant Department much of this class of work is handled by the Service Supervisor. To handle the circuit layout work which must be done in the Plant Department requires a force of over twenty people. Members of this force attend daily meetings of the Circuit Layout Committees comprising representatives from the Engineering, Traffic, and Plant Departments. They also issue telephone and telegraph circuit layout orders, keep track of the available facilities for special contract service, answer inquiries from the Commercial Department as to whether service desired by customers can be furnished, and are continually making studies to improve the telegraph layout. Over 500 circuit orders are issued each year placing new telephone facilities in service or making changes and rearrangements in existing facilities. They have a card record of upward of 30,000 cards containing detailed records of about 3,900 telephone circuits for message business and about 215 telephone circuits for full talking circuit contracts. Details of about a thousand telegraph circuits are shown on charts which they keep.

The Construction Supervisor's work, in addition to the routine supervisory phases involving checking costs, schedules, and material requirements, includes the co-ordination of all schedules for work done in the different Divisions, either by the Division forces or for the Divisions by the Western Electric Company or an Associated Company, so that a complete project extending through various territories will not be held up by one unit of the organization.

The Supervisor of Instruction has prepared training courses in which more than eleven hundred employees are now enrolled, and supervises the carrying on of these courses.

The bulk of the work done in the General Office is supervisory. General instructions are issued covering methods and specific instructions sent out about individual items. Estimates and expenditures are checked and results are checked by reports and inspections and by comparison between territories and with results in previous years.

In planning both the organization and the work of the Plant Department, responsibility for each thing that has to be done is definitely allocated. While much of the work may seem intricate, there are simply an enormous lot of ordinary little things to be done, and the problem is to set up the best type of organization for doing them, placing definite responsibility for the different things on specific parts of the organization and arranging the organization so that things which have to be done are done promptly, economically and without duplication of effort.

There are many hundred things that can happen between the terminals of a long distance circuit which will make it impossible for that circuit to give satisfactory service to the public. It is the job of the Plant Department to see, so far as is humanly possible to do so, that none of these hundreds of things happens.

T. G. MILLER.

The Bell Public Address System

"And when they were now come where the most valiant stood, thronging about mighty Diomedes, tamer of horses, then stood forth the white-armed goddess Hera and shouted in the likeness of great-hearted Stentor with voice of bronze, whose cry was loud as the cry of fifty other men."

THE ILIAD—*Homer.*

THUS sung the poet, Homer, in the era of Greek mythology and his reference to Stentor, a herald of the Trojan war whose cry was loud as the voices of fifty other men, shows the inherent desire which has existed in mankind since the dawn of history to magnify the human voice. The word "stentor" has become a fixture in all languages, signifying the desire to speak so loudly as to make oneself heard throughout vast spaces.

From the time of Stentor down to a period within the last one or two years no human being has ever possessed a voice equal to this character of mythology. It remained for the Bell engineers to turn mythology into fact, and today through the Bell Public Address System any man can have the power not only of fifty voices but of fifty thousand times fifty voices.

A brief description of this very remarkable apparatus for magnifying the human voice will no doubt prove of interest. In the first place, it is necessary to have a transmitter for picking up the voice sounds which will be so sensitive as to operate when placed five or six feet distant from the speaker's lips. In addition, this transmitter must not reinforce certain of the voice tones because of resonance of its diaphragm or mouthpiece opening to these tones. The above requirements were met by the design of a transmitter operating without a mouthpiece and provided with a special alloy diaphragm which is so tightly stretched by means of a clamping ring that its natural rate of vibration is far above any of the harmonics in the human voice.

The electrical output of such a transmitter although faithfully simulating all the overtones of the human

voice represents only a very minute amount of electrical power due to the speaker being several feet away and the air waves having to act upon a highly resisting diaphragm under great tension. In order to build up this small electrical power into quantities that will successfully operate loud speaking receivers, it is necessary to bring into play that most remarkable device of the past few years, the three-electrode vacuum tube. The vacuum tube has aptly been called the "Aladdin Lamp" of the telephone, for with it today we can perform previously undreamed of feats in economical long distance telephone transmission by the successive amplification of weak telephone currents at intervals along the line.

By using a number of these vacuum tubes in series in conjunction with a considerable amount of very intricate and very complicated electrical control machinery, the volume of the minute electrical current from the transmitter before the speaker is built up several hundred million times. It has been estimated that the electrical energy delivered by a single one of the high power amplifiers of a Public Address System is sufficient to operate simultaneously at normal volume all of the twelve million telephone receivers of the Bell System in the United States.

In order to produce loud speaking results in practice, the electrical energy from the high power amplifier is delivered to specially designed telephone receivers which, on account of the large amounts of power they can absorb, may be looked upon as electrical motors for transforming electrical energy into the energy of air waves. These special receivers or projectors, as they may more properly be called, have a diaphragm made of corrugated impregnated linen which permits a wide amplitude of vibration and therefore produces intense sound waves in the adjacent air.

For amplification indoors in auditoriums, churches, banquet halls and theatres, a number of projectors are used, each one connected to a fiber horn about three feet

in length. The electrical power input to the projectors is adjusted so that the volume of sound will be comfortably loud in all parts of the auditorium. Many buildings are now being provided with permanent installations of Public Address Systems.

For outdoor occasions, the projectors are connected to square wooden horns about fifteen feet long and having a cross-section which varies from an inch at the receiver end to several feet at the mouth of the horn. A battery of eight or ten of these horns spaced uniformly around a circle when supplied with the highest power from the amplifier will enable a speaker's voice to be heard by at least five hundred thousand people gathered within a diameter of half a mile.

Some time ago one of these high power "loud speakers," as they are sometimes called, was installed experimentally in the Catskill Mountains and under favorable conditions it was possible to hear the speaker's voice for three and one-half miles through one of the mountain valleys. Not since the days of Rip Van Winkle when the mystic crew of Hendrik Hudson were reputed to play at ten-pins with thunder clouds have these peaceful valleys reverberated to such a mighty volume of sound.

The Bell Public Address System has been successfully used at many great gatherings such as the inauguration of President Harding, the Arlington ceremonies at the burial of the Unknown American, the dedication of the Lincoln Memorial and other similar occasions. At the time of the burial of the Unknown American, a total assemblage of one hundred and fifty thousand people heard every word of the Arlington ceremonies by means of loud speakers located at Arlington, New York, and San Francisco, interconnected by the Long Distance Telephone Lines.

The latest successful application of the Public Address System was the joint meeting held February 14-17, 1923, by the American Institute of Electrical Engineers in New York and Chicago. Some of the papers were pre-

sented in New York and some in Chicago, but every one in both audiences in the two cities heard all the papers and the ensuing discussions. In addition, as an extra feature, a wire connection was made to WEAF, the Bell broadcasting station in New York, which sent out simultaneously by radio the proceedings in both cities.

As an indication of the practical value of the Bell Public Address System, the following statement of Mr. Elliot H. Goodwin, Vice-President of the National Chamber of Commerce of the United States of America, is very conclusive.

> "The amplifier has become a feature of our Annual Meeting which we could not contemplate doing away with at future meetings."

In the telephone loud speaker, telephone engineers have put into the hands of civilization one of the greatest instrumentalities for good and progress. Great leaders of men of the type of Washington, Lincoln, Grant and others now have this MODERN STENTOR by means of which they can reach simultaneously by word of mouth hundreds of thousands of people many miles apart and thus promptly bind together the nation in its current affairs and in its great crises.

SERGIUS P. GRACE.

Some Personnel Problems of Foreign Telephone Systems

ON a certain occasion the Chief Electrical Engineer of a large telephone system, while visiting one of the exchanges, observed an operator in the act of disobeying instructions. The girl was summoned to the manager's office. There, in the presence of the manager, the supervisor, and the Chief Engineer, the case was stated, and the manager was requested to see that the operator did not repeat the act. The only reply the operator made was to ask that the matter be investigated by a legally constituted Board of Inquiry.

This incident, which occurred in Australia, succinctly illustrates a state of mind that is unfortunately prevalent among telephone employees in many countries. It indicates a psychological condition which arises inevitably from certain specific causes, and which as inevitably produces certain concrete results. This mental condition, its causes and its results, constitute a personnel problem which for decades has confronted, and is still confronting, the executives of many foreign telephone systems.

Telephone Success Dependent on Personnel

While the state of mind of the employees, their attitude toward their work and toward their superiors in the organization is of vital importance in any business undertaking, this is peculiarly true of the telephone service. The proper development, operation and extension of telephone systems is an enterprise of an intensely complex and technical character. It calls for the highest degree of ability, initiative and cooperation throughout the engineering and administrative personnel. Unless the employees work with their hearts, as well as with their heads, a satisfactory service cannot be given.

The tremendous advance of the telephone art, in this country, during the last twenty years has been made pos-

sible only by the constant employment of large numbers of competent research engineers, who are continually developing new apparatus and new methods for improving the quality and reducing the expense of telephonic communication. Engineering and organizing skill of the highest quality is required, also, for the adequate maintenance of the exceedingly intricate central office plant, the complicated web of urban telephone wires, and the tremendous stretches of long distance lines and cables, which, with the connecting network of small town systems and remote farmers' lines, make up the great nerve system of a nation-wide telephone service.

Moreover, the telephone is a natural monopoly, and this in itself entails a special responsibility toward the public. If a satisfactory service is to be given, those upon whom this responsibility rests must be men of such calibre as to insure that the policies of the organization shall be at once sound and progressive; and they must have sufficient authority to enable them to recruit and retain a staff of competent and willing subordinates. The men who construct and maintain the telephone plant and the girls who operate the switchboards should, in the interest of efficient service, be as satisfactory and as satisfied in their respective positions as are the engineering and administrative officers in theirs. Indeed, to the public, for whose service the whole organization exists, the telephone system is largely personified in the operator, and by her efficiency it is frequently judged.

Picking the Best Man for the Job

In order to maintain a satisfactory and satisfied personnel it is essential that a telephone organization should be in a position to attract the right people to its employ, to keep them after it has got them, and to eliminate any who prove to be incompetent or otherwise unsatisfactory.

A telephone corporation, operated by private enterprise, is of course able and willing to do all these things. If, for example, the Chief Engineer of such a telephone

corporation requires the services of a capable engineer for special research work, or to fill a vacancy in the organization, he can make a search for a man with the requisite qualifications, and when he finds the right man he can hire him without more ado. If it later develops that the individual selected is not, after all, the right one for the position, his superiors are entirely free to transfer him to any other work in the organization for which he appears to be adequately equipped or, if no other opportunity is available, to release him. Should he prove to be so valuable as to command greater remuneration, the men higher up can adjust his salary accordingly. It is an unfettered transaction.

Civil Service Restrictions

In telephone systems under government ownership and operation, however, conditions are necessarily different.

If the Chief Engineer of such a telephone service wishes to take on a new man for a particular position, he is not at liberty to seek out such a man as he desires, hire him, and later promote or release him as may seem best. Like an executive in any other government department, he is necessarily restricted in all his dealings with his subordinates by the necessity of strict conformity to civil service requirements.

Civil service rules, in general, prescribe appointment by examination, promotion by rule, and security of tenure, with dismissal only for proven misconduct. While, to be sure, the details of such regulations differ somewhat in different countries, and from time to time in any one country, the general effect of the system is everywhere and always the same. It makes it difficult to fill vacancies, difficult to promote men of outstanding ability, and difficult to eliminate the unfit.

Wrestling with Red Tape

If, for example, a well qualified telephone engineer applies for a position in a government owned telephone

system, and the executives desire to employ him, they must either obtain authority to increase the staff by creating a new position, or else they must advise the applicant to enter the competition for some existing vacancy. An increase in the telephone staff, of course, means an increase in governmental expenditure, and the final decision as to taking on more men therefore rests, not with the telephone executives who are responsible for the service, but with the Treasury, or, in the last analysis, with the Parliament, which authorizes the expenditure of public funds. Permission to increase the telephone staff is, therefore, too often either refused from motives of economy, more or less irrespective of the needs of the service, or else given only after considerable delay. Even where there has been a serious shortage of staff, government telephone executives have found it expedient to wait, sometimes for months, until it has been demonstrated beyond peradventure that the shortage is permanent, before so much as requesting authority to take on new men. After permission has been granted there are still, in the words of a one time Engineer-in-Chief of the British Post Office, "a lot of little formalities to be gone through."

Vacancies, whether created by an increase in the authorized personnel or by withdrawals from the organization, must in many cases be advertised, and time allowed for the filing of applications. Examinations must be held, the examination papers read and graded, and certificates must be issued by the civil service authorities to those who pass. All in all, it is, to quote another foreign telephone official, "a somewhat tedious matter to get a staff."

Thus, although a position may be open, and the very man for the place may be available, telephone executives compelled to operate under civil service rules cannot appoint such an applicant until he has qualified in a competitive examination. These examinations, by the way, often cover literary and other educational subjects with

which an experienced technical expert may well have been long out of touch. Some civil service systems go so far as to require that all candidates for certain responsible positions start at "the same place on the ladder"; and in those cases, of course, a well qualified telephone engineer from outside the service cannot, even if he passes the examination, be given a position commensurate with his value.

Inadequate Salaries

The insufficiency of government pay in the higher grades of the service is another potent influence in deterring ambitious men from taking up telephone work in countries where the wire systems are publicly owned. In Australia, in France, in Great Britain, in practically every country whose records have been examined, the complaint of inadequate salaries and "want of appreciation of men with scientific attainments" has been raised again and again. The frankest official commentary on this situation that has yet been found is recorded in the Report of the (British) Select Committee on Post Office Servants, 1907, which stated that, in the opinion of the Department, in view of the character of the work performed, "the rates of pay and the avenues of promotion were adequate"; and that "the government was obliged to tolerate, owing to Parliamentary pressure, a degree of inefficiency which in private employment would lead to dismissal of the employee."

A striking illustration of the strictness with which government departments adhere to the policy of keeping the salaries of their supervisory and technical employees within very moderate limits, was afforded by the British Post Office when it acquired the telephone system of the privately owned National Telephone Company on December 31, 1911. One of the earliest announcements made by the Post Office authorities after the decision was reached to acquire the company's business, was that

the Post Office would not take over any employee of the telephone company whose salary was in excess of £700 per annum. The Post Office had been operating the long distance telephone lines throughout Great Britain since 1896, and since 1902 had been operating a local telephone system in London as well. Nevertheless, in 1911, it was not paying, and was not willing to pay, salaries as high as those of the more important executives of the National Telephone Company. On acquiring the company's exchange system, the Post Office dispensed with the services of the most proficient telephone executives in the organization, in preference to continuing the salaries which they had earned under private enterprise.

Ten years later the scale of pay in the British postal service was still a subject of satirical comment in the London press. An official announcement of a Post Office examination covering historical, economic and scientific subjects, algebra, geometry, electricity, telegraphy and telephony, including automatic telephony and wireless, was published in a London paper, a year or two ago, under the heading: "Chance for a Genius: What the General Post Office Expects for £100 a Year."

Barriers to Promotion

The necessary rigidity of civil service organization not only makes it difficult to attract the sort of men needed in a technical undertaking like the telephone system, but it also practically precludes the granting of such concessions as may be necessary, under certain circumstances, to keep good men in the service.

In some government services it is specifically prescribed that the basis of promotion shall be merit alone; in others both merit and seniority are to be taken into account. Under either system, however, the degree of advancement which may be granted, even to the most meritorious, is strictly limited by fixed scales of pay for fixed grades, or ranks. Moreover, in some cases increases

in salary after certain definite periods of service are made matters of right. In New Zealand the system has been carried to its logical conclusion, and postal, telegraph and telephone employees have actually been given the right to object, under certain circumstances, before a Court of Appeal, to increases in pay granted to others, if they themselves have not received like increases.

Rules governing promotion differ, to be sure, in different countries. They are, however, an essential part of every civil service system, for the very object of civil service regulation is to prevent the intrusion of politics into the public services. Were promotion left within the uncontrolled discretion of departmental executives, it is argued that it would open almost as wide a loophole for favoritism as would the abolition of competitive examinations for appointment. Yet the very rigidity of the system makes impracticable the adequate recognition of exceptional merit. Brilliant men "can do better outside"; and the inevitable tendency is, therefore, to encourage mediocrity at the expense of ability. This tendency cannot fail to have serious effects in any organization; and especially in a highly complex and technical service like the telephone business.

The telephone art is still young, and depends for its future progress upon the employment of engineers of rather exceptional ability, not only in the construction and operating departments of the service, but also in technical research. One of the commonest, and certainly one of the most costly, mistakes that governments the world over have been prone to make in the operation of business enterprises, has been the restriction of research work from motives of economy. Private enterprise has proved again and again that, in technical operations, moderate or even generous expenditures for research are far more than repaid by the savings made possible through the introduction of improved methods and equipment.

Governments, however, have been slow to recognize this truth.

Difficulty of Raising Salaries

Difficult as it is, under civil service regulations, to give adequate salaries to exceptional employees, it is equally difficult to give adequate salaries to ordinary employees under exceptional circumstances. The same rigidity which hinders the promotion of individuals, hampers the management in meeting the exigencies of unusual situations.

Government telephone departments in many countries have been criticized for not raising the salaries of their employees during and after the war to an extent commensurate with contemporaneous wage advances in private undertakings. It has been answered, however,—and the point is well taken—that such wage increases in private employment were for the most part temporary, whereas corresponding advances in the government service would have imposed a permanent burden upon the taxpayers. A private employer, it has been pointed out, may at any time discharge his staff and replace them with new employees at lower wages, whereas the government service is, "subject to efficiency and good conduct," a permanent service, and its rates of pay are for permanent employment.

Protection of the Inefficient

The very fact, however, that employment in government service is permanent, "subject to efficiency and good conduct," is a formidable stumbling block in the path of telephone executives, in many countries, for in practice this generally means that dismissal is possible only after the preferment and proof of definite charges. Of course, under government ownership this must be so if the entire service is not to be placed at the mercy of

political appointments. But however necessary it may be, telephone officials, who can neither "hire nor fire" their own assistants, have frequently testified that this limitation of their authority is directly subversive of discipline.

The incident already cited of the Australian telephone operator who, when detected by one of the principal officers of the system in the act of disobeying instructions, stood upon her rights and demanded an official investigation, is unfortunately typical of a state of mind which too often results from the knowledge that dismissal may be had only on proof of formal charges. Inefficiency, indifference, and general slackness may, indeed, be made legal grounds for removal; but these are matters which are difficult, if not impossible, to prove by legal evidence. Busy executives often prefer not to press charges of incompetence against an employee, rather than give up their time to testifying before a Board of Inquiry,—with a very good chance that, in any case, at the end of the trial the charge may be held not to have been legally proved.

In one of the official investigations of the Australia Postal Services (which include the telephone and telegraph systems) a senior inspector told of being fourteen days before such a Board, "partly under examination by defendant's solicitor." Even then, he said, the charge was not considered sustained, although he "was perfectly satisfied" that the accused employee "was guilty of incompetency."

The Royal Commission on the Australian Postal Services, which elicited this testimony (and much more to the same effect), expressed the opinion in its final report that it was "essential for the efficient working of the service that the management of the Department should be provided with more effective machinery to deal with incompetent officers."

Not a Temporary Condition

The condition, however, was not a temporary one. Five years after this recommendation was made, another official investigation of the Australian postal, telephone and telegraph services disclosed similar troubles; and ten years after the first investigation, "this practice of having things decided by an outside tribunal" was still being criticized in the Australian Parliament as having "tended largely to inefficiency in the (postal) service."

The fact of the matter is, of course, that difficulty in eliminating unsatisfactory government employees is a permanent condition. It is not peculiar to Australia; it is found in every country in which large staffs are employed in services operating under civil service regulations. Many responsible executives in governmental undertakings freely admit the existence of this condition, and complain bitterly of the handicap under which it places them in their relations with their subordinates. Efforts have been made from time to time in many countries to remedy the situation, but without any considerable or permanent success.

The reason is not far to seek. The condition is inherent in the system of governmental organization. It is woven into the very warp and woof of the governmental fabric. It has a very real and essential reason for existence; and if it were effectively remedied the cure would necessarily be worse than the disease.

Guarding Against the Spoils System

"To the victors belong the spoils" has been a political slogan for so many years and in so many countries that it is now generally recognized that the only effective method of preventing the filling of government jobs by appointees selected under the spoils system is through unyielding adherence to the principles of civil service reform, viz.: appointment by competitive examination;

promotion according to regulations; and protection against dismissal, except for proven misconduct.

Civil service regulations have, indeed, secured continuity of employment for the rank and file of those in the public service, but this has been accomplished only by sacrificing much of the authority over the personnel which should be exercised by the responsible executives. The deleterious effect of this lack of authority is, of course, most clearly seen in branches of government service, which, like the publicly-owned telephone systems, are most directly dependent for success upon the quality of their personnel. Nevertheless, in the case of a government-owned utility, the abolition or serious weakening of civil service regulations would inevitably pave the way for still greater abuses in the shape of appointments, promotions and dismissals dictated by political considerations.

Legislative Interference

Even the rigidity of civil service rules seems incapable of completely eliminating Parliamentary interference in questions pertaining to departmental personnel. Government employees the world over are prone to regard their legislative representatives as a court of appeals for the redress of grievances, real or imaginary, incurred at the hands of their superiors. Of course, the greater the number of government employees, the greater is the political influence which they exercise; and the evil potentialities of the system are, therefore, greatest in those countries in which government enterprises are most extensive. Every additional industry that is nationalized swells the ranks of the civil servants, and correspondingly increases their political power and the consequent independence of their attitude toward their superiors in the government service.

Aside from direct pressure by members of Parliament in behalf of individual government employees seeking advancement or fighting dismissal, there is another form

of Parliamentary interference which takes the time of departmental executives and the money of the taxpayers, often without any very tangible benefits, viz.: legislative investigations.

Perhaps the attitude of the harassed telephone official, compelled to carry on as best he may in the face of innumerable difficulties, was never more succinctly summed up than in a remark of Sir William Noble, Engineer-in-Chief to the British Post Office in 1921, before a Parliamentary Select Committee on the Telephone Service. When asked for his opinion as to what would help to improve the general conduct of the British telephone service, Sir William replied: "The view of 99% of the officials, I believe, is 'Leave us alone to get on with the job.'"

Changing Heads and Changing Policies

Even if left strictly alone by Parliament, however, the executives of government-owned telephone systems would still be unable to lay down any general policy that would not be subject to reversal on a change of administration. The heads of government departments are necessarily cabinet ministers, and cabinet ministers obviously cannot be selected by civil service examinations. They must be appointed by the administration. Public utilities operated by government departments, therefore, necessarily face the loss of their chief executives whenever there is a change of administration; or, indeed, whenever the exigencies of party politics so require. The London press is at present publishing complaints from business men as to the prejudicial effect on the British telephone service of frequent changes in the Postmaster-Generalship, four different incumbents having held that office during the period between October, 1922, and the end of May, 1923. Of course, continuity of policy is impossible in an organization the administrative head of which is constantly changing. In the case of certain government-owned telephone systems this has had far-

reaching effects in precluding consistent adherence to any plan of development or financing, the execution of which must extend over a period of years.

Carrying on Under Difficulties

The administration of a telephone system subject to political control is certainly not an easy task. The executive in such an organization, though responsible for the conduct of a highly technical business peculiarly dependent upon its personnel, nevertheless may not select his own assistants. He may not raise their salaries in order to keep them if they are efficient. He may not dismiss them unless he is able to secure their conviction on legal evidence of misconduct. He must answer to Members of Parliament if he offends their constituents; and he must appear and testify before Boards, Commissions and Committees, until he cries, as did Sir William Noble, when Engineer-in-Chief of the British Post Office: "Leave us alone to get on with the job."

Nor are these disadvantages capable of more than temporary and partial alleviation, so long as the enterprise remains under governmental operation. Investigations are made, reforms are recommended, legislation is enacted; but in country after country, and year after year in the same country, similar difficulties are brought to light. They are inherent in the very nature of governmental organization. If the spoils system is to be avoided, there must, of necessity, be rigid civil service regulation of the appointment, promotion and dismissal of the staff. Yet the very rigidity of the civil service system, which is so discouraging to the ambitious, unavoidably causes, in the mediocre, a feeling of security against dismissal. The inevitable result of this feeling, in many individuals, is an attitude of indifference toward the work and toward the wishes and orders of the responsible executives. Once this attitude becomes widespread among the rank and file, it cannot fail to be reflected in the quality of the service rendered. In short, government departments are, by

nature, subject to deep-rooted and incurable difficulties as regards personnel which definitely unfit them for the successful operation of business enterprises.

Indeed, great credit is due to the devoted executives of government telephone systems in many countries, who have labored, and are laboring, under tremendous handicaps, to give the public as good a telephone service as can be attained under government ownership.

RICHARD STORRS COE.

NOTE: Mr. Coe is of the staff of the Chief Statistician of the American Telephone and Telegraph Company.—*Editor.*

The Telephone Directory

IN the infancy of the telephone business lists of subscribers were published, primarily to encourage the use of the telephone and invite additional patrons.

These early lists, which were the forerunners of the present day telephone directory, originally grouped the names of subscribers alphabetically under headings indicating the class of business. The first function of the telephone directory was largely one of publicity.

With the development of the business, it became impossible to handle calls by name, and number designations were introduced. As an aid to patrons in identifying telephone numbers, the business designation and street address were included with the name and telephone number as a definite part of the basic listing data, with the result that the directory took on a rather definite function in directional service.

In the beginnings of the business it was possible to include the listings of all subscribers in a single book. With the development of toll lines and increased exchange development an effort was made to continue this plan, and for several years a national telephone directory was published which contained the listings of all Bell System subscribers in the United States, between whom toll communication was possible.

As the business grew it was, however, found impracticable to continue this directory because of the number of listings involved. Accordingly, telephone directories have been developed to embrace one or more exchange areas.

Reference Value of the Classified Section

With increased use of the telephone, the directories came to have a service value in addition to that of telephone directional service, since by the inclusion of classified sections they furnished a certain general or business directional service formerly only provided by city and

trade directories. With the addition of the classified section, the directory has served increasingly as a business guide, directing the consumer to the supplier and the supplier to the consumer.

The expense of publishing the first directories was small, and did not materially affect the character of the book. With growth, however, directory expenses increased to the point where it became necessary to develop improved manufacturing methods, economize in the use of paper, and secure additional advertising revenues, although advertising had been included in the earliest books.

The basic information contained in the telephone directory is the listing, which includes four items—the subscriber's name, business designation, address, and telephone number. Where the size and character of the territory covered by a directory warrant, a classified section is included. In the majority of cases directories include more than a single exchange area. The scope of a given book is determined largely by the amount and distribution of traffic between given areas. Thus the directories conform to geographical areas which include localities having a definite community of interest.

Public Acceptance of the Telephone Directory as a Business Guide

At the present time telephone directories largely fill the place formerly occupied by city directories, and the classified sections of telephone directories are being used more and more as buyers' guides. There is evidence, also, that the business world of today is rapidly coming to realize the value of the data which the telephone company has accumulated as a by-product of the telephone business, and to appreciate the usefulness of this information to present day business needs.

Developments in the arts of printing and paper making have reduced unit directory expenses substantially,

but the ever increasing volume of information to be published involves costs of considerable proportions. The directory expense problem involves a balance between economy of production and service value of the book which affords a most intimate and constant contact between subscribers and the telephone company. A great deal has been accomplished in the way of economy through bulk purchases under centralized production contracts, but a point is being approached beyond which the possibility of further reductions in costs is limited unless new processes can be developed.

While revenues from directory advertising are substantial, and in recent years have been rapidly increasing to the point where directory revenues as a whole very nearly equal expenses, it seems probable that the tendency of directory practice in the future will be in the direction of furnishing more, rather than less information than at present. Directory information furnished subscribers must continue, under conditions of increasing complexity, to serve the purposes of telephone directional information.

This information must be sufficiently inclusive to furnish subscribers with listing information for as large a portion as possible of the calls they place. The introduction of machine switching calls for somewhat more explicit directory information, and the rapid growth of the telephone business present great difficulties in the way of furnishing adequate information in metropolitan districts. The increasing area of business activity as a result of growing use of toll service will require the furnishing of directory information for areas considerably outside of given local exchange areas.

Possibly the solution of these problems lies in the direction of supplementing the present type of directory by furnishing certain classes of subscribers with selected directory information, adapted to their individual or class needs, such as specialized trade directories for business uses, neighborhood directories, etc.

Some Future Uses of Directory Data

The telephone directory contains a vast fund of valuable and currently corrected data which are not elsewhere available. This fund of general and business directional information is and probably will continue to be an increasing source of revenue through the more general publication of classified sections. This information might be used, for example, for trade directory purposes or for commodity lists such as might make it possible for national advertisers to link their products with local dealers and consumers.

It is probable that classified sections will develop along lines which will maintain the continuity of listings and increase the value of the classified section as a reference list and business guide. The classified section is approaching the status of a real buyer's guide, which is resulting in a more general use of directories and more business to the advertiser.

In general it would seem that telephone directories will develop along the line of providing a broader and more comprehensive telephone and business directional service, in order to:

(a) Meet the requirements of the steady and rapid growth of the telephone business.

(b) Furnish general and business directional service in a more complete way, and provide the means for meeting the demands of the business world, which today accepts the telephone directory as an essential medium.

(c) Discharge certain economic obligations which exist by reason of the fact that the telephone directory includes valuable data which can be made available to business generally.

(d) Supplement the telephone service program of cooperation with the telephone-using public.

It is difficult for one not immediately associated with the telephone directory problem to appreciate its magnitude. At the present time there are about 2,500 telephone directories used in the Bell System with a total annual circulation of 25,000,000 copies and requiring over 30,000 tons of paper each year.

The last national directory issued in 1897 which included the listings of all stations in the United States between which toll communication was then possible, had a page 9x12 inches and was 1¼ inches thick with a total circulation per issue of 150,000 copies requiring approximately 225 tons of paper.

To combine the listings of telephone subscribers in the United States between whom toll communication is now possible, in a single similar volume, would require a book 9 feet thick and a single issue distributed to all subscribers in the System would consume 1,500,000 tons of paper.

One issue of the 2,500 directories required today if laid end to end would reach from New York to Denver and would require for transportation about 600 freight cars of 50,000 pounds' capacity each, which, if made up into solid trains, would make 10 trains of 60 cars each.

O. C. Lyon.

Abstracts of Recent Technical Papers from Bell System Sources

Radio Transmission Measurements, by Ralph Bown, C. R. Englund and H. T. Friis.[1] The paper divides naturally into three sections. The first section briefly analyses the radio transmission circuit into (a) the sending or radiating portion, (b) the transmitting portion consisting of the ether path through which the radiated waves travel, and (c) the receiving portion. The relation of these from the standpoint of the radio transmission engineer is discussed, pointing out the need of quantitative data as to electric field strengths of waves and of radio noise conditions to allow of rational design of radio systems.

The second section is devoted to descriptions of apparatus which has been developed for measuring electric field strengths of radio waves, its theory and method of use. Illustrative data are given showing useful practical results already obtained at both short and long wave lengths. The short wave length data pertain to ship-to-shore telephony and to radio broadcasting in New York City. A vector diagram is given showing the strength of signals received from three New York broadcasting stations at all quarters of the compass. The long wave length data pertain to transatlantic telephony.

The third section deals with the measurement of radio noise and a useful method is described and illustrated by data from recent transatlantic telephone tests.

Apparatus for Admitting Gas into a Vacuum,[2] by J. B. Johnson and H. W. Weinhart. The authors describe apparatus whereby small measured quantities of gas may be admitted to an evacuated chamber. It is essentially an inverted Toeplar pump to which a second adjustable mercury column is connected. The latter is so arranged

[1]Proc. of the Inst. of Radio Engineers, April 1923.

[2]Journal of the Optical Society of America and Review of Scientific Instruments. Vol. 7, page 175, Feb. 1923.

that both the pressure and the volume of the admitted gas may be determined. A diagram is given which shows the arrangement of the different parts of the apparatus. They describe a method of attaching the gas reservoir which prevents loss or contamination of the gas.

Relations of Carrier and Side Bands in Radio Transmission,[3] by R. V. L. Hartley. This paper discusses generally the characteristics of carrier transmission as applied in radio and in carrier current communication over wires and analyses the factors which affect the faithfulness with which such systems reproduce the signals imparted to them. It is shown that transmission of both side bands results in a certain distortion due to the beating of the various frequency components of the side bands with one another. But since the amplitude of any difference frequency is proportional to the product of the amplitudes of its two generating frequencies, the distortion can be reduced below a troublesome value by maintaining the original amplitude of the carrier sufficiently large with respect to the amplitudes of the signal components. The results indicate that the good quality which is obtained when the carrier component is large falls off very rapidly as the magnitude of the carrier component is reduced so as to approach that of a side band, the latter being measured when a sustained "ah" is used as a signal. Under these conditions the side band is maintained at a value about equal to the maximum occurring in ordinary speech.

The advantages of carrier and side band suppression are pointed out, among which are reduced distortion due to interaction of the side band components and the reduction of interference from messages on nearby wave lengths. The conclusion is reached that single side band transmission offers advantages in radio telephony while double side band transmission offers greater advantages in radio telegraphy.

[3]Bell System Technical Journal Apr. 1923.

The Crystal Structures of the System Palladium-Hydrogen,[4] by L. W. McKeehan. The occlusion of hydrogen by metallic palladium at ordinary temperatures has been of interest for many years as representing an extreme case of an effect observed in many other metal-gas systems. Conflicting theories have been proposed to explain the phenomena, but hitherto no crucial experiment to decide between them has been possible. The present paper deals with measurement by means of X-rays of the form and dimensions of the palladium space-lattice with and without the presence of occluded hydrogen. It is found that very pure palladium crystals are uniformly distended by about 3.5 per cent in linear dimensions (11 per cent in volume) when saturated with hydrogen. The process is reversible, but intermediate stages are much less stable than either extreme, indicating a kind of limited miscibility. The exact positions of the hydrogen atoms was not determinable. The linear increase of electrical resistance with hydrogen content is explained. A bibliography of 66 titles is appended.

The Crystal Structure of Iron-Nickel Alloys,[5] by L. W. McKeehan. Alloys extending from pure iron to pure nickel were examined by means of X-rays in a variety of physical conditions as obtained by cold-work and heat treatment. The body-centered-cubic space lattice of iron is predominant up to 30 per cent of nickel, the face-centered-cubic space lattice of nickel is the only one observed above this nickel content, but can be obtained in lower nickel alloys by suitable treatment. The dimensions of the crystals of either pure metal are slightly but uniformly increased by substitution of atoms of the other, suggesting certain speculations regarding the shapes of the atoms. The permalloy range of alloys is not distinguished by any abnormal type or scale of crystal structure.

[4]Physical Review, Vol. 21, pp. 334–342, March 1923.
[5]Physical Review, Vol. 21, pp. 402–407, April, 1923.

Public Address Systems,[1] by I. W. Green and J. P. Maxfield. A public address system comprises electrical equipment to greatly amplify a speaker's voice so it will reach a much larger assemblage than he could speak to unaided. Beginning with the presidential conventions of the two major parties in 1920 and the inaugural address of President Harding in March 1921, when a special address system installed by the telephone engineers enabled him to address an audience estimated at 125,000, there followed in rapid succession, many public events demonstrating the value of such systems. One of the most notable of these occurred on Armistice Day 1921, when the speeches, prayers and music at Arlington, Virginia, were heard, not only by 100,000 persons gathered there at the National Cemetery, but by some 35,000 in New York City and 20,000 in San Francisco. On this occasion the three public address systems, one for each of these cities, were joined by long distance telephone circuits.

The fundamental requirements of a satisfactory public address system are naturalness of reproduction and wide range of output volume. The meeting of these two requirements for music proves more difficult than for speech.

The public address system here described is most readily considered in three sections—"pick-up" apparatus which is placed in the neighborhood of the speaker and converts his words into undulatory currents; a vacuum tube amplifier for amplifying these currents; and a "receiver-projector" for reconverting the current into sound waves and distributing the sound over all of the audience. In the present system each of these three parts of the equipment has been designed with the intention of making it as nearly distortionless as possible, so that the various parts might be adaptable for audiences ranging in size from possibly one thousand to several hundred thousand, and might also be used in connection with the

[1]Presented at the Midwinter Convention of the A. I. E. E., New York, N. Y., February 14–17, 1923. Published in the Journal of the A. I. E. E. for April, 1923, and in the Bell System Technical Journal for April, 1923.

long distance telephone lines and with either radio broadcasting or receiving stations. One of the larger public address systems is easily capable of magnifying a speaker's voice as many as 10,000 times.

The pick-up device whether of the carbon microphone variety or a condenser transmitter need not be placed close to the speaker's lips but will operate satisfactorily when four or five feet away. The loud-speaking receiver mechanism is so designed that it will carry a power of several watts with small distortion. Under normal conditions, 40 watts distributed among a number of receiver-projectors arranged in a circle is ample to reach an audience of 700,000 persons.

Use of Public Address System with Telephone Lines,[7] by W. H. Martin and A. B. Clark. The combination of the public address system and the telephone lines makes it possible for a speaker to address, simultaneously, audiences located at a number of different places. Such a combination has been used in connection with several public events and a description is given of the system as used on Armistice Day, 1921, when large audiences at Arlington, New York and San Francisco joined in the ceremonies attending the burial of the Unknown Soldier, at the National Cemetery, Arlington, Virginia.

More recently the public address system has been used in conjunction with telephone lines to attain two-way loud-speaker service. This arrangement permits the holding of joint meetings between audiences in two or more locations, separated by perhaps thousands of miles, in such a manner that speakers before each of the audiences can be heard simultaneously by the other audiences. A demonstration of two-way operation was given at the mid-winter convention of the American Institute of Electrical Engineers in February, 1923, and took the form of a joint meeting between 1,000 members in New York and 500 in Chicago.

[7]Presented at the Midwinter Convention of the A. I. E. E., New York, N. Y., February 14–17, 1923. Published in the Journal of the A. I. E. E. for April, 1923, and in the Bell System Technical Journal for April, 1923.

The electrical characteristics of any telephone line which is to be used in conjunction with loud-speaker equipment must receive special attention. In commercial telephone service the main requirement is understandability, while with the loud-speaker naturalness of reproduced speech is very important. People are accustomed to hearing through the air with very little distortion and naturally expect the same result with loud speakers. A satisfactory line for this purpose must show freedom from transients, echo effects, etc., as well as good uniformity of transmission over the proper frequency range.

The public address system, apparatus and methods has also been applied to radio broadcasting. The combination of the public address system with lines and radio makes it possible for one speaker to address enormous numbers of people located all over the country.

Impedance of Smooth Lines, and Design of Simulating Networks,[8] by Ray S. Hoyt. The impedance characteristics of telephone lines are of considerable importance in various phases of telephone engineering; and particularly important in the applications of two-way telephone repeaters. Moreover, to permit the use of the best types of repeater circuits, impedance networks are required for closely balancing the impedances of the associated telephone lines throughout the telephonic frequency range.

This paper, which pertains only to smooth lines (as distinguished from periodically loaded lines), aims to present in a simple yet comprehensive manner the dependence of the impedance of the various types of smooth lines on the frequency and on the line constants, by means of description accompanied by equations transformed to the most suitable forms and by graphs of those equations.

Also, the paper describes the principal networks devised by the writer for simulating the impedance of the various types of smooth lines. It includes first approximation design-formulas, and outlines a supplementary semi-

[8]Bell System Technical Journal, Apr. 1923.

graphical method for arriving at the best proportioning of the networks.

Audiometric Methods and Their Applications, by E. P. Fowler, M.D., and R. L. Wegel.[9] An audiometer is described by means of which the sensitivity of any ear can be determined at a large number of frequencies between the lower and upper limits of audibility. In this way the sensitivity of the ear for any frequency can be compared to that of the normal ear. The paper gives many conclusions, some of which are as follows:

1. In an audiogram the most serviceable scale of intensity is proportional to the logarithm of the stimulus.

2. The tone from an oscillator should be so pure that the error in reading due to the presence of harmonics is less than the observational error.

3. A current attenuator should be free from interference between the initial and attenuated currents.

4. Most commercial telephone receivers, when used in an audiometer, introduce intolerable errors.

5. Measurements made among different subjects show similarity as to general form of the curve for the two ears.

6. The two ears show close coincidence not only of form but of per cent of hearing in certain cases of similar and also of quite dissimilar lesions.

7. The curves are quite even showing no inordinate dips or rises.

8. The audiometer provides means for accurately noting the peculiarities and rate of progressive loss or improvement of hearing and also furnishes a basis for building deaf sets to bring defective auditory areas up to a given level instead of simply increasing equally the loudness of all sounds transmitted to the ear.

Signal-To-Static-Interference Ratio in RadioTelephony,[10] by John R. Carson. This note discusses the signal-to-static-interference ratio in the two systems of radio telephony involving double side band transmission and single side band transmission. Considering first carrier suppression, it is stated that under ideal conditions the ratio of signal-to-static-interference can be as large in

[9]Transactions of the American Laryngological, Rhinological and Otological Society, Inc. 1922.

[10]Proceedings of The Institute of Radio Engineers, Vol. 2, page 271, 1923.

double side band transmission as in single but this result would be difficult to obtain in practice. The following two conclusions are given:

a. The signal-to-interference ratio in double side-band transmission with carrier *suppressed* is one-half the corresponding ratio in single side-band transmission, when account is taken of the phase and frequency variations from synchronism of the local carrier or homodyne wave.

b. The signal-to-interference ratio in double side-band transmission with carrier *transmitted* is $1/(1+c)$ times the corresponding ratio in single side-band transmission, where c is the ratio of the unmodulated carrier energy to the side-band energy in the former system.

It is stated that in practice the value of c is about two or three. Therefore in addition to the very important gain in economy of the frequency range, single side band transmission enjoys the added advantage to a very substantial gain in the signal-to-static-interference ration.

Practical Application of Carrier Telephony and Telegraphy in the Bell System,[11] by Arthur F. Rose. The present paper summarizes the application of carrier in the Bell System and gives typical examples of situations in which it has been found more economical than other types of facilities. Carrier systems are economical only on the longer circuits in the plant because of the cost of terminal equipment. At the present time there are nearly 15,000 channel miles of carrier telephone and 84,000 channel miles of carrier telegraph in the Bell System.

Looking forward for the next ten years, it is expected that carrier telephone facilities will be installed at the rate of about 5,000 to 10,000 channel miles and telegraph facilities at the rate of from 20,000 to 30,000 channel miles per year. In the meantime development work may produce cheaper systems which will prove in on shorter circuits thereby extending the field of use so that the rate of application may possibly be doubled or trebled.

[11]Bell System Technical Journal, April 1923.

Notes on Recent Occurences

GENERAL TRAFFIC CONFERENCE

THE General Traffic Conference, held at Pinehurst, N. C., April 12 to 21, was the largest and perhaps most successful general traffic conference ever held in the Bell System. In all there was a total attendance of one hundred and thirty, including not only all General Traffic Managers and Superintendents, but many of their principal staff and division men, with a large representation from the New York headquarters staff of the American Company for all or part of the conference, including Mr. Thayer, Mr. Houston, Mr. Gherardi and Mr. Hall.

At the General Traffic Conference in New York in June, 1920, emphasis was laid on the necessity and means for restoring service. At the series of special conferences early in 1921, after service had generally been restored, the keynote was economy. With service and efficiency both on a high plane of excellence now practically everywhere, the recent Pinehurst Conference dealt with both general and technical problems and was aimed to bring out the importance of maintaining a balanced performance and effecting such further improvements as seem possible both in the way of economies and in special aspects of service, and in preparing for less favorable conditions should they eventuate, particularly by strengthening personnel and public relations.

Toll service and costs and the efficient use of toll lines was a subject that was given special consideration. With toll message traffic and revenue estimated to increase well over 100% during the next ten years, the ever-increasing importance of this subject is evident. It developed as a general conclusion that average speed of toll service under normal conditions was felt to be reasonably satisfactory and that further developments in this direction lay, not so much in trying to cut a minute or so from the present average, as by eliminating the avoidable cases

of long delay and getting the service, where possible, on a more direct basis. The extension of the A-B method and its improvement, or the development possibly of some better method for handling short-haul traffic, is one of the immediate problems ahead of us. Bringing this about should both speed up the short-haul service, where the greatest demand for fast service exists, and develop latent and potential business. It also offers the best promise of ability to handle this class of business profitably. In connection with the short-haul direct handling methods, particularly tandem, the possibilities of substantial improvement in accuracy, through some form of so-called straightforward trunking, were discussed. In the matter of long-haul and switched traffic, developments along the lines of the dispatch method and improved relay methods, involving so-called operator-per-circuit plan, were discussed. The field for application of machine switching to toll lines was described and discussed. New toll switchboards will be involved in the development of these new and special operating methods, and these were discussed, as well as the likelihood of the advisability, with future increase in size of boards, of sub-dividing some of the larger units into two or more smaller ones to solve some of the supervisory and management problems.

During the next ten years toll line investment is also expected to increase and in even faster proportion than traffic. The make-up of the toll line plant will also change. Toll cable circuits have increased 190% in the last seven years as contrasted with open wire circuit growth of about 40%. There are now about 1,000,000 miles of toll cable circuit and 1,100,000 of open wire circuit, nearly half the toll circuit mileage therefore already being in cable.

In spite of the growing size and importance of toll service, the exchange service is recognized as still being the backbone of traffic work. In the local exchange work the principal immediate opportunities for improvement

were brought out as lying in minor improvements, important chiefly in their cumulative effect. In this connection emphasis was laid particularly on the desirability of considering service, not only from a technical traffic standpoint, but also, and specifically, from the viewpoint of the public. It was brought out that data now available as to auxiliary service, such as calls handled by information, multiple marking and complaint desks, and by supervisors, disclose opportunities for better methods and service on this relatively small but very important portion of the traffic work. There were papers and discussion covering practically all important phases of central office management, such as load control, force adjustment, peg count, central office instruction, selecting and training of supervisors, voice technique and quiet operating, and dependability of fundamental traffic records.

Machine switching service was covered in several discussions. Service results were reviewed both absolutely and compared with manual. Traffic engineering and operating problems and modifications in practices and organization were considered. Meeting the problems of the future will require, it was shown, not only the further development and extensive introduction of machine switching equipment but further development and extension of manual boards. It was brought out, however, that in spite of the countless difficulties which had arisen or were foreseen in connection with both development of machine switching equipment and operating practices and in the unobstructed interconnection of machine switching and manual service, successful and practical ways of meeting every difficulty arising have so far been found and thoroughly satisfactory service demonstrated as possible under all conditions.

There was very profitable interchange of ideas on the general business and employment situations throughout the country.

Some of the most important subjects of all those covered at the conference and to which more time was

devoted than to any others were both the general and specific phases of the problems arising and constructive measures being employed in Traffic Departments in furthering the aims with respect to employee representation, personnel relations and public relations.

One of the outstanding facts about this General Traffic Conference was the close agreement and unity of opinion generally regarding the main aspects of different matters discussed which seems to warrant the conclusion that traffic methods are generally on a sound basis for the attainment of the traffic objectives. This situation has come about as a result of efforts for many years to bring about sound standardization of equipment and operating and management practices, and is of special significance in view of the scope of the field which is covered in traffic operations and which was represented at this conference.

PLANT AND ENGINEERING CONFERENCE AT SHAWNEE

FROM May 15 to 24 inclusive, a conference was held at the Buckwood Inn, Shawnee-on-Delaware, Pa. attended by the Chief Engineers, the General Plant Managers and Superintendents and the Plant Methods Supervisors of the various companies comprising the Bell System in the United States and Canada; also by representatives of the Western Electric Company, the Northern Electric Company and the American Telephone and Telegraph Company.

The spirit of the conference and its purposes are well expressed in the remarks of Mr. Bancroft Gherardi, Vice President and Chief Engineer of the American Telephone and Telegraph Company, at its closing.

"If we were in a position where the System was confronted by a crisis of any kind—a crisis in regard to its operating conditions, a crisis in regard to its relations with its employees, a crisis in regard to its relations with the public, or a crisis in regard to its finance, it would be easy

to sum up and lay emphasis on the critical situation, whatever it might be. Looking at the general situation, however, as it is throughout the country, it seems to me that we are in a position which is just the reverse of having a crisis in any phase of our work. We had some exceedingly difficult situations during and after the war, but since that time things in every line of our work have been getting better, and although they are not 100 per cent, and never will be 100 per cent, and we cannot afford at any time to relax our efforts, nevertheless there is no one point upon which in my judgment it would be pertinent to lay extraordinary stress at the present time. There are, however, some points which I should like to mention. They are points that have stood out as I have listened to the discussions during the last ten days.

"The first one is—I do not know that I need to say that it has been brought to my mind many times during the conference—the very important part which the General Superintendents of Plant, the Chief Engineers and the Supervisors of Plant have in the operation of the System. They have under their care property rapidly approaching a total of 2 billion dollars. They are making additions to that property at the present time at a rate approaching 250 million dollars a year. They have under their charge, employees totaling approximately 100,000. In addition, there are perhaps 50,000 employees in the Western Electric Company. That company, as it should, being part of the System, has been represented with us throughout the whole conference.

"The next point I wish to refer to is the matter of investment per station,—its increase at the present time. I know that each of you will do all you can, and all that ought to be done to keep this investment down as far as practicable. We cannot unduly jeopardize the service; we cannot unduly jeopardize the connecting of new subscribers, but as far as consistent with these requirements, we must keep our eye on that investment.

"Toll service and the use of toll lines is a matter on

which we still have a good ways to go. As we go further, the System will be just that much better off.

"I am not going to speak of any of the specific points in regard to Plant Measurements and their use. I am just going to say that better Measurements and their use by the field people as they are made available, should, we believe, bring about more favorable results, both in the quality of the service and in the cost of rendering that service.

"Before Mr. Barnard came, I, as you know, stole his thunder on the subject of Functional Operation and General Management. He was the man who crystalized my ideas on that subject, and was the one who presented that topic to the General Managers at their conference last fall. I believe it is a point of view that should always be kept in mind, and it seems to me that your people and you yourselves, and everyone concerned, will get practically that point of view if, when considering any question to be decided, you ask yourselves this question: 'How would the General Manager decide if he had all the facts before him; not only the facts as to my part of it and my function, but the facts in regard to the effect my decision of the question may have upon the other departments, upon the public, upon the employees, and upon the showing of the Company as a whole.'

"I will not undertake to say anything about Personnel and Public Relations immediately after that which Mr. Hall, Mr. Lynch and Mr. Barnard have said on the question. All of you, and each of you, I know, have already done so much in your own respective fields, and have seen so much of the good that can come from that point of view and from that work, that it is quite unnecessary for me to add anything more to it, except to say that I do not know of anything which has been more satisfactory than watching the progress of the System along these lines during the last three years."

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"In closing a conference such as this, I think of the

map of the United States and Canada, and of the Bell System; that map, including almost the entire area of the continent, is covered by a supervisory organization which is represented here in this room, and which, a week from now, will be scattered over that map from the East to the West, and from the North to the South.

"We have assembled here to exchange ideas, to discuss our problems, and to confer in a manner which will enable each of us to do his part of the job in such a way that ours will be indeed one System, will be the best System in the world, and that each of us will know what the others have in mind and what the others are doing, so that we may apply that knowledge to our own particular problem and get the very best results that can be obtained, considering the conditions of the local problem to be met."

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"I know that when I go back, Mr. Thayer will ask me, 'How about the conference?' and it is a great satisfaction to me to know that I shall be glad not only to say to Mr. Thayer that in my judgment the conference was successful and helpful, but also to assure him he need have no concern as to the plant operation or the engineering of the Bell System and to further assure him that what I knew already has been confirmed by all that I have seen and heard in this conference, that is, that the plant operation and engineering forces of the System are in good and progressive hands, that good results have been obtained since our last conference, and that we are not spending much time thinking or talking about these results, except as it may help us to do still better in the future."

THE PRESIDENTS' CONFERENCE

THE presidents of the Associated Companies of the Bell System met with the executives of the American Telephone and Telegraph Company for a five-day conference at Yama Farms, on May 26th.

It was the fourth annual meeting of the System's executives to confer on plans and policies that would enable the System successfully to meet its responsibility to furnish a national telephone service of the best possible quality and at the lowest possible cost.

The progress made in reaching objectives along the lines of economy and efficiency defined at previous conferences, was found to be most encouraging.

The growth of the System was shown to be even greater than had been anticipated and on a substantial basis. Problems in connection with financing and building the plant extensions required for the continuing demand of the public for service, were discussed in detail, and improvements in means and methods of operation were carefully considered.

Much evidence was given of the high morale of the operating forces and of the increasing cooperation of telephone users due to a better understanding of the System's problems, purposes and standards. Plans were made for adding still further to the public's general knowledge of the System and for securing the public's cooperation.

Particularly interesting were the accounts of the recent developments and improvements of the communications art achieved by the System's scientists and research engineers.

A feature of the conference was the adoption of a Bell System flag which is pictured elsewhere in this magazine, to be flown from hundreds of Bell-owned buildings, to suggest the national character of the service as well as the immense physical resources of the Bell System.

A PRIVACY RADIO SYSTEM FOR CATALINA ISLAND

THE radio telephone system linking Catalina Island, thirty miles off the California coast, with Los Angeles, has been equipped with a new development of Bell System engineers which may be called a privacy

system for the radio telephone. The new system was placed in service on June 9, and the preliminary tests and actual use in service show that speech is as good in quality and volume as before its introduction, and is not intelligible to those attempting to listen to it with ordinary radio receiving apparatus.

The radio link was placed in service in 1920 when, as a result of conditions arising from the war, submarine cable was difficult to obtain and its use, although it would have provided a better grade of service at less expense, would have involved considerable delay. Suitable cable will be available in the near future and will be laid to the island, but not before the new private radio system has been given a thorough trial. Not only will the cable make it possible to handle traffic more economically and more satisfactorily in all other respects than the radio system, even with privacy assured, but it will make the ether waves now used for the radio system available for broadcasting or other essential radio services.

Heretofore the Catalina Island radio service, while providing speech transmission which has been clear and understandable to those using it, has lacked privacy, since conversations could be picked up by radio receiving stations in the neighborhood, if tuned to the proper wave length.

It was largely to remedy this situation that the privacy system was designed by engineers of the American Telephone & Telegraph Company. It is not claimed that the new system is absolutely secret but it affords privacy to the extent that conversations transmitted over it cannot be inadvertently overheard. Briefly, the messages are distorted or "scrambled" so that no receiving set not specially designed and manipulated to receive them can obtain anything intelligible.

While it is possible to design a set capable of listening to the system, such a set would be much more complicated than the ordinary set and the added complication would be of no value except for picking up transmission over

this system. The system has been likened to a lock and key, which provide practical protection against intrusion, although it may be possible to make a key which will open the lock, however complicated. While the privacy radio system does not preclude the possibility of designing a special set sufficiently like the receiving set used by the system itself to transform the message into more or less intelligible form, it does insure privacy of conversation for all practical purposes.

Not only does the wireless link connect the island with Los Angeles but, through the trunk lines of the Bell System, it puts the residents of the island in telephonic touch with every commercial center of the United States. It was part of the longest telephone circuit on record when, in the opening of the Havana-Key West submarine telephone cable, a circuit of over 5,000 miles was established, by radio, by land wires and by cable, between Catalina Island and Cuba.

IN HONOR OF THE DEAD OVERSEAS

IN honor of the Americans who lost their lives in the military service during the war, and particularly in honor of the former Bell System employees who are buried abroad, the American Telephone and Telegraph Company has made a contribution to the American Overseas Memorial Day Association Fund being raised by the American Legion.

Sixty-seven graves of former Bell System employees, buried overseas, have been definitely located and arrangements were made through representatives of the system abroad to decorate all of these last Memorial Day. In addition to these, five employees are listed as missing in action and there are eleven others as to whom information is incomplete.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY OPENS NEW BROADCASTING STUDIOS IN NEW YORK

THE new broadcasting studios for use in connection with Station WEAF of the American Telephone and Telegraph Company were formally opened on the evening of April 30. These studios are located at 195 Broadway, New York City, and embody important modifications adopted in an endeavor to improve the quality of broadcasting.

In July, 1922, the Company began broadcasting through Station WEAF with a single studio located in the Walker-Lispenard Building at 24 Walker Street. Although this studio was designed in accordance with the best practice known to the radio art at that time, the experience of six months indicated desirable modifications in studio design. It was also found that the location at Walker Street was not sufficiently accessible for the many artists who take part in the broadcasting programs; consequently, the new studios are located in the Telephone and Telegraph Building at 195 Broadway. Special telephone circuits connect the studios with the radio transmitting equipment at Walker Street.

The two outstanding improvements in the new studios are: (1) means to eliminate waits in programs by the use of two studios, and (2) a more effective monitoring equipment by the installation of a novel announcer's booth.

A large studio is provided for bands, orchestras and glee clubs. A small studio is used for soloists and speakers. While an orchestra is being assembled about the microphone in the large studio, a singer or speaker is broadcasting from the small studio. When the singer has completed a number and the orchestra is ready, the large studio is switched on without any delay; hence, it is possible to alternate from one studio to the other without

lapses in the program. Artists may rest between numbers, because the necessity of singing six or seven numbers successively is eliminated.

The announcer's booth is located between the two studios and has large clear vision windows enabling the announcer to *see* what is going on in both studios. Special precautions have been taken to sound-insulate the booth so that the announcer does not *hear* directly what is going on in the studio, but within the booth is located a small monitoring loud speaker actuated by the microphone currents from the studios. Thus the announcer hears the studio music exactly as it is sent into the ether for the radio audience or, if he so desires, as rendered in the idle studio where the artists are preparing to broadcast. In this manner he controls the placing of instruments and the action of performers in the studio as determined by the radio output; that is, from the standpoint of the radio audience. This new feature eliminates the mistakes in placing of instruments which occur when the announcer or studio director is in the studio where the artists perform. His ear is not able to judge correctly what is going "on the air," from hearing the music being rendered in the studio.

A loud speaking equipment in each studio connected with the announcing microphone enables the announcer to check up the correct pronunciation of titles of selections and names of artists while broadcasting is going on from the other studio. By means of the same loud speaking equipment, introductory announcements are automatically repeated for the information of the artists about to broadcast. In this way each artist knows how and when he is introduced to the radio audience and is ready to follow the announcer promptly.

The loud speakers in the studios can be used for another purpose. When a studio is not on the air, the announcer can switch his microphone so as to actuate the loud speaker in that studio. Thus he can communicate any suggestions or instructions to the artists without

leaving his booth, in order to correct any fault observed in the placement of instruments or artists.

The reception room has been comfortably furnished to give a homelike atmosphere. A concealed loud speaking equipment gives the artists the radio program as picked up by a loop receiving set while they wait their turn to appear before the microphone.

On the opening evening a special program covering a wide range of entertainment was broadcast for the benefit of the newspaper men, music and dramatic critics and the radio editors who attended. Mr. Edgar S. Bloom, Vice-President of the American Telephone and Telegraph Company, opened the new studio and in the course of his remarks, gave a brief history of the Company's broadcasting activities.

"The American Telephone and Telegraph Company began broadcasting on July 25, 1922, on 360 meter wave length, being on the air twelve hours weekly. On October 2, 1922, we changed to 400 meter wave length, which has been used since that time and we are now broadcasting about thirty hours weekly.

"During the nine months that we have broadcast, nearly 200 of America's leading statesmen and citizens have spoken to you through WEAF, also many stars of the first magnitude in the theatrical and motion picture world. Over 200 separate programs have been broadcast involving a total of 3,000 people including artists. According to our best estimate, there are probably upwards of three-quarters of a million radio receiving sets within the area easily reached by our station and, as these sets will probably average not less than three listeners per set, we have a possible audience of between two and three million people."